Factory

MANAGEMENT AND MAINTENANCE

Vol. 94, No. 11 — NOVEMBER, 1936

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Factory Management and Maintenance is a consolidation of *Factory and Industrial Management* (including *"Factory"*) and *Maintenance Engineering*

Price 35c. a copy. Subscription rates—United States, Canada, Mexico and Central and South American countries, $3 a year. All other countries, $4 a year or 16 shillings. Cable address "McGrawhill, New York." Member of A.B.P. Member A.B.C. Copyright, 1936, by McGraw-Hill Publishing Co., Inc.

Factory Management and Maintenance, November, 1936. Vol. 94; No. 11. Published monthly. McGraw-Hill Publishing Company, Inc. Publication office, 99–129 North Broadway, Albany, N. Y. Editorial and executive offices, 330 West 42d Street, New York, N. Y. Application for entry as second-class matter at Albany, N. Y., pending. Printed in U. S. A.

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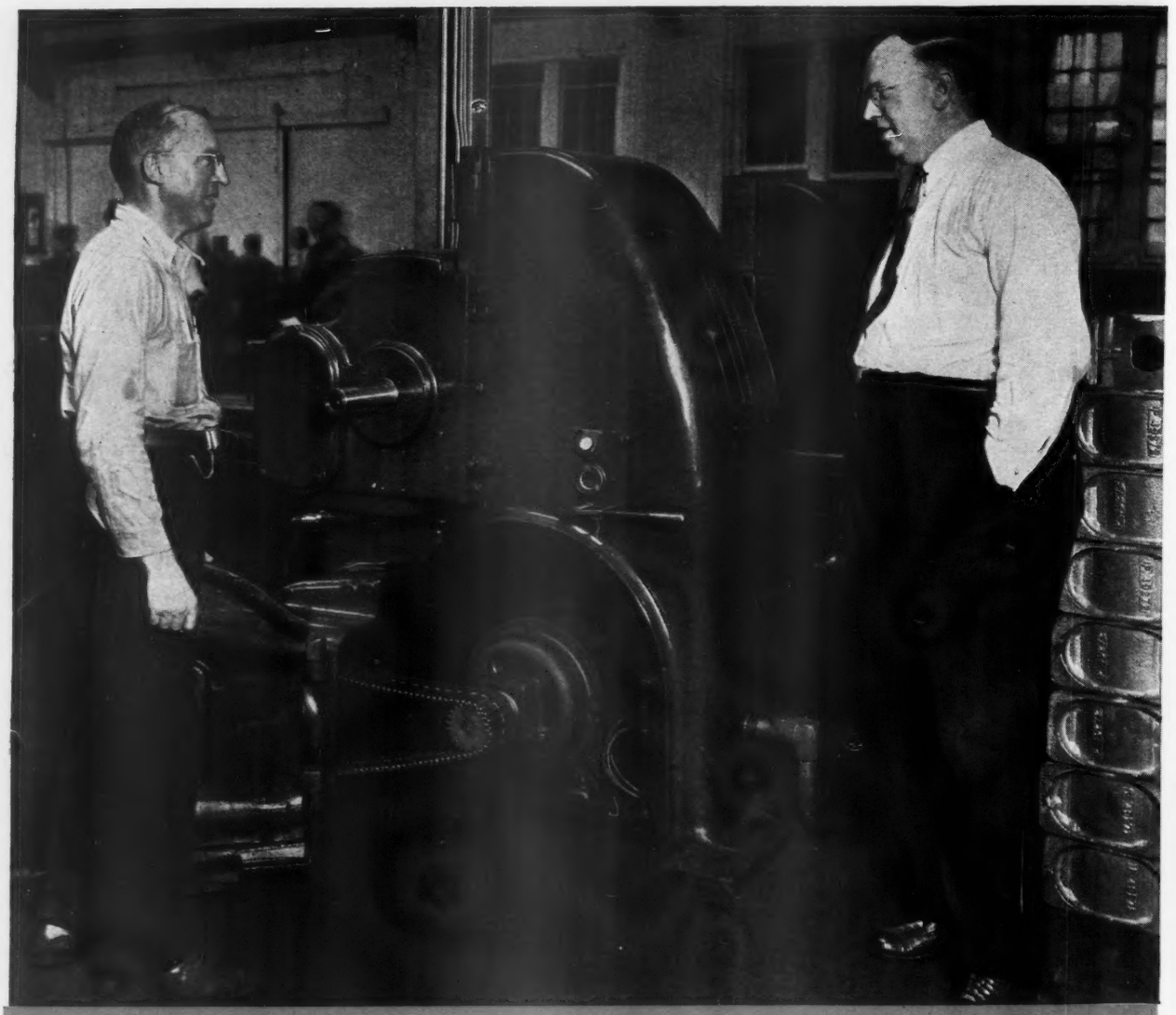

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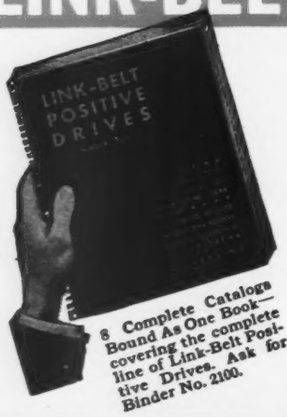

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Factory
MANAGEMENT AND MAINTENANCE

L. C. MORROW
Editor

Employees Want to Know

OLD MAN DEPRESSION certainly is responsible for a lot of inquiring minds. Almost everybody in a supervisory capacity and many of the workers on machine and bench are trying to find out the what's and why's of industry and its relation to living.

Why is there sometimes a scarcity of workers and why sometimes a scarcity of jobs? Why sometimes fat pay envelopes, sometimes lean ones, sometimes none at all? Do machines create or destroy jobs? Can the work week be shortened? Can wages go up?

These questions are very much on the minds of industry's people. Where are they going to get the answers? To us it seems that they naturally and rightfully look to industry for them. If that is so, industry has a public relations job to do in interpreting itself to its employees.

How can this job be done? There are several means: Company publications, foremen's and workers' study classes, employee associations, pay envelope stuffers, shop posters, distribution of specially prepared literature. All of these methods are by way of dealing directly with employees.

There is another method, quite influential, and valuable because it also serves to interpret industry to both employees and the public at large. That is the method of making facts available to people whose occupations are such that their utterances are natural influences upon public opinion. They are educators, editors, preachers, people in the public eye.

The facts presented can be of two kinds, general and specific. The former deal with industry in the abstract, the latter with the particular plant doing the public and employee relations job. The two can be done at the same time provided the specific is presented as case material to illustrate the general.

Any industrial concern undertaking an educational campaign obviously should first put its own house in order. There is something biblical about a mote and a beam that applies. When he who tries to teach practical economics lives according to his teaching he has a fair opportunity of having his statements believed. Otherwise he is likely to be judged as is the proverbial local prophet.

This educational job is one that should be regularly done. It should be done regardless of political party in power and regardless of the prosperity and depression cycle. There is every reason why the essential services of industry should be understood by most of the people all of the time.

We Work Toward

Security for wage earners begins with steady jobs at good pay under best working conditions. Those are prime objectives in any program for worker security. Where to go from there, depends upon ability to pay. Packard, for instance, feels its way with separation pay, retirement allowances, vacations with pay—pays for them out of the savings that are made by cutting costs without taking anything out of the product

THE DESIRE to provide security, good pay, fine working conditions for industrial employees is not something that has been newly hatched since the depression. The depression had a good deal to do with bringing into sharper focus some aspects of the need for such things, but to many a thoughtful employer they have been objectives for many years—how many years I do not know, but certainly during the 40 years of my own business experience.

Nor was there a lack of progress toward these goals. Any man of my age and experience in industry could from memory construct a list covering many typewritten pages with merely the names of the manufacturers who have taken long steps in the right direction. In the past score of years there have been so many additions to this list—companies supplying group insurance, retirement plans, separation wages, guaranteed employment, year-round pay, just to confine ourselves to the social security side of the picture—that any fair-minded critic of industry must admit that great progress has been made.

All this, mind you, was voluntary. It came because the owners and managers of these businesses saw these needs and felt that their institutions could safely stand the additional cost.

Admittedly this progress has been slow, but so is all sound building on solid foundations slow, painstaking work. The comparative slowness has been due not to any unwillingness of industry to provide ideal conditions of security and the rest, but rather because experience has shown these managers and owners of industry that such changes must be made gradually and tested thoroughly step by step if they are to endure as lasting gains in the advance toward perfection.

Haste Makes Waste

Any attempt to hasten the process unduly must necessarily result in false steps which will set back the ultimate progress for which we are all of us sincerely eager. You and I know, in our own businesses, that any attempt to revamp an entire production operation along theoretical lines, or to shift distribution methods at right angles to what they have been, is almost certain to result in financial disaster.

If, on the other hand, we try out our new production theory in one small department, find out by trial and error what is wrong with it, strengthen its weak points and learn from its strong points, we eventually emerge—if the idea was basically sound—with something we can safely try on a larger scale. After it has been thoroughly tested and approved is time enough to shift over the entire plant. Once we have it in successful operation, the rest of the industry will adopt it and put the entire industry on a basis of greater efficiency.

We have all been reminded from time to time that not the owners of the business, not the management, but the consuming public pays our salaries, our wages, all other costs. We all know there exists an unremitting competition not only among rival companies, but also among entire industries to give the consumer such value that he will spend his dollars in the desired way.

For example, consider the industry that I know best, automobiles. In the first place, the Packard Motor

Car Company must produce cars of such quality and at such prices that the public will buy a profitable volume of Packards in preference to other makes of automobiles. Our One Twenty, for instance, is priced at from $990 to $1,115 f.o.b. Detroit. It is the best automobile we now know how to produce to sell at this price, and a worth-while proportion of the public shows its agreement with our opinion by buying these cars. But there are other excellent cars selling at this price or in the immediate neighborhood.

Suppose that we, in our earnest desire to improve the lot of the company's employees, embark on a program that gives our workers guaranties of social security materially ahead of those afforded by makers of other good automobiles in the general price class of the Packard One Twenty. The money to provide these added benefits to Packard employees must come out of the selling price of the car; certainly the average yearly returns to the owners of the company are not sufficient to provide the slack for making such social advances, and the only other available source is the consumer.

Let us assume, then, that we raise the Detroit f.o.b. price $100. Let us further assume, what our valued competitors would strongly contest, that even at this higher price the One Twenty is still better value than anything else on the market in this range.

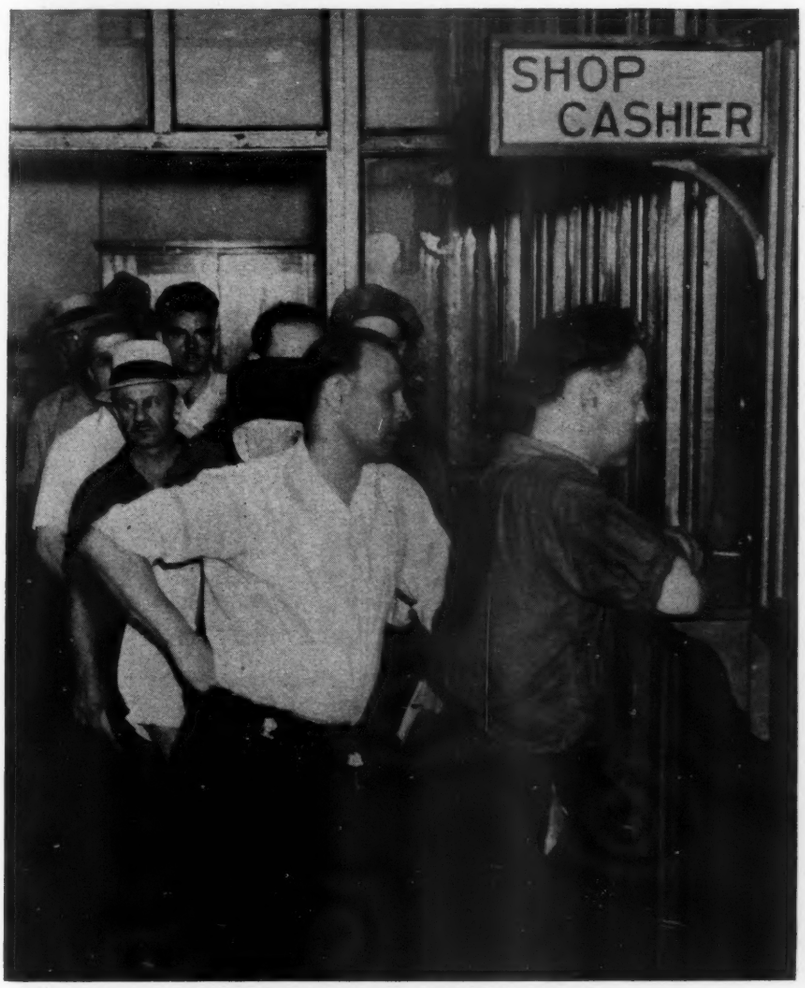
In the first place we should immediately lose those sales that are made to buyers who have so high a regard for some other car that even at about $1,000 f.o.b. they hesitate a long while between our product and the other fellow's. Second, we should lose those buyers who are already stretching their budgets to the limit to buy as fine a car as this.

Adding together these two groups of people who now buy One Twenties but who would not buy them at the higher price, we should necessarily lose a block of sales large enough to cut our production schedules. Therefore we should either have to reduce our factory employment or work shorter hours. In either event this would not only play hob with profits, but it would also leave our factory workers as a group in a worse condition than before we embarked on our high-minded program of well-doing.

But, suppose that, instead of

Worker Security

ALVAN MACAULEY
President, Packard Motor Car Company



Packard employees getting their vacation pay

•

"The theorist who falsely assumes that a labor-saving machine decreases employment is 100 per cent wrong. It may briefly dislocate a few jobs, but because it permits the manufacturer to give a better product for the same or a lower price, it increases consumption of goods and quickly increases employment all along the line. It is from betterments in design, in production, from all manner of savings that we may look for the wherewithal to provide better things for industrial workers on a basis unshakable and sound"

Packard's starting such a program single-handed, all automobile manufacturers simultaneously granted their employees these new benefits, so that every automobile on the market would advance approximately $100 in price. Our competitive situation within the industry would remain essentially the same as it is right now—with this exception, that we should necessarily lose the sales to those buyers who could not afford the added $10 or so per month.

The entire industry would, however, lose a substantial volume of sales. There would be many people who, torn between the desire for a new car and a new set of living room furniture, would buy the furniture. Every other industry would increase its sales at the expense of the automobile industry. The social consequences would be far more serious in the dislocation of employment available to automobile workers than it would be in the loss of revenue to stockholders. It is indeed more than possible that under such circumstances there would be a decrease in the number of automobile factories and automobile parts factories, with a permanent shrinkage of employment as well as huge capital losses.

Now let us assume instead that this program of well-doing were undertaken by every industry. We have assumed that such a program would add perhaps 10 per cent to the cost of a Packard One Twenty. It would probably add about the same percentage to the cost of all products of all industry, if undertaken on an all-industry basis; it would therefore remove any competitive advantage to any laggard industry, because no industry would be lagging. There would still be the loss of sales to those consumers who were barely able to purchase automobiles, but the same thing would apply to the sales of every industry except perhaps those dealing in the barest of necessities.

Only So Much to Spend

After all, the consumer has only so many dollars to spend. If 10 per cent of his dollars should thus be diverted into providing social security for industrial workers, he would have to curtail all his purchases. Inevitably this would cause shutdowns, failures, would throw huge numbers of factory workers out of employment. And it would thus—as we have all seen during the recent depression—pile up farm products surpluses, decrease employment in distributive enterprises, service enterprises, all along the line.

It all boils down to this—there are only so many dollars available for purchasing commodities for any family or person gainfully employed. If too much of this person's income is diverted into other channels, all relationships of our economic world must be thrown out of balance, even disrupted.

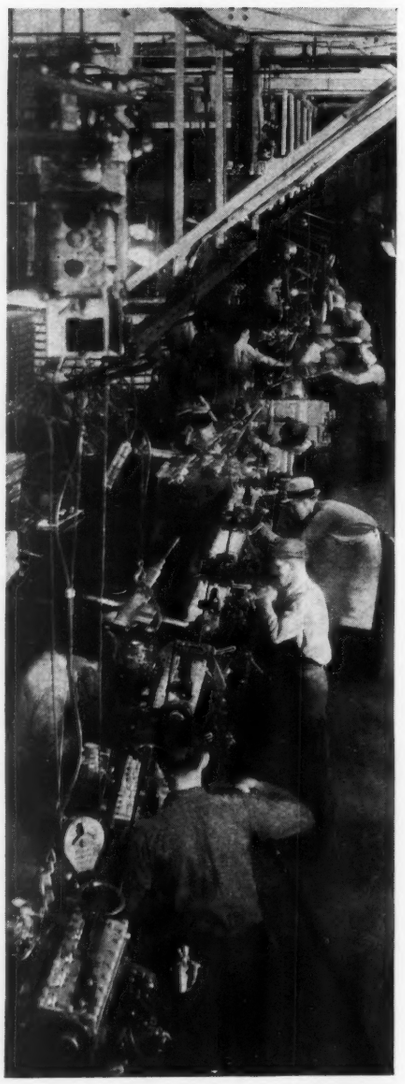
Does this sound like a plea for scuttling all advances in the direction of providing greater security for workers, of discarding any idea of paying higher wages, of forgetting all ideals of bettering the working conditions in industry? Certainly it is not so intended. I know that improvements can be made in all these directions. I feel sure that the men and women who own and operate the nation's factories wish to make such improvements. I know also that there is a perfectly workable, practical, solid way to attain these improvements in such a way that there will not be false steps taken with subsequent harm to such progress as a whole.

The Path to Progress

The one road to greater prosperity—I am not referring to recovery from the depression that started on its destructive path in 1929, but rather refer to the economic betterment of the entire population over the long term—lies in producing more goods that people need at prices they can afford to pay.

We have seen graphically what this can mean for recovery in the record of the automobile industry. Nobody can deny that the automobile that lists at $1,000 today is a better car than the one for which we had to charge $1,500 or even $2,000 for ten years ago. It is so much better than the automobile of a few years ago—and so, within its price range, is the car that lists at $500 or $5,000—that the public feels it simply must have the new cars. Thus has come about a tremendous lift in national figures of employment, in consumption of raw and manufactured materials, and so on.

The theorist who falsely assumes that a labor-saving machine decreases employment is 100 per cent wrong. It may briefly dislocate a few jobs, but it increases consumption of goods and quickly increases employment all along the line because it permits the manufacturer to give a better product for the same or a lower price. It is from betterments in design, in production, from all manner of savings that we may look for the wherewithal to provide better things for industrial workers on a basis unshakable and sound.



"The one road to greater prosperity lies in producing more goods that people need at prices they can afford to pay"

We have recently seen exactly how this works out, by an instance in our own business. It has been through advanced design, competent engineering, more economical production methods, that our company has developed automobiles that the public is buying in large enough volume to supply full employment and a fair return to the owners. Consequently we have been able to take one or two steps toward the goal we visualize as ultimately attainable and always desirable.

Back many years ago we supplied

our employees, under specified conditions, with group life and disability insurance. This program was not disturbed during the depression. We also, in pre-depression years, gave one week's vacation with full pay to any factory worker who had been with us for five years or more, and gave two weeks' vacation to any factory worker with ten years or more of service. When the depression hit us hard, we suspended this vacation program, preferring for the greatest good to the greatest number to use the money it had cost to keep a good many employees on the payroll who otherwise must have been laid off. This purpose was universally understood by the employees affected, and was generally approved by them.

Recently, with business much better and with savings piling up through the large increase in our attained volume, we felt that the time had arrived when we could safely take on a vacation policy once more. But we also felt that it should touch a larger number of employees. Likewise, we had seen through the catastrophies of the depression years the need for certain other improvements in the status of workers.

New Plan Announced

We studied the problem for a long while because we wished to avoid mistakes. Early in June of 1936 we announced our plan, which touches not only factory vacations but also dismissal wages and retirement allowances.

Mind you, we have no illusions that this plan is perfect. It has, however, been keenly appreciated by our employees, and we are glad of the opportunity of putting it in effect. As it stands, we have not only restored a vacation plan on more nearly universal scale than before the depression, but we have also for the first time in our company's history seen our way clear to make some provision for the employee who must be laid off and for the man who reaches the age where he can no longer carry his own weight in the plant organization.

Briefly, the plan starts with what we term a vacation credit. For each full month that an hourly rated employee works after June 1—the plan was made retroactive to June 1, 1935, so that the vacations could start this year instead of being deferred to 1937—he receives a vacation credit of one-half day, four hours. Thus the employee who has worked continuously since June 1, 1935, has twelve such half-day credits, or a total of six days. An employee must have six full days' credit before he is entitled to a vacation with pay.

Our intention is that, within reasonable limits, an employee may take his vacation at a time most convenient to him. With the November announcement of new models in the automobile industry, it happens that the slackest period comes in midsummer, which is the time when most vacations are desired. Naturally, we shall not encourage many employees to take their vacations at the height of the busy season, but this season fortunately comes at a period when few of the factory people will desire their vacations.

Enough to See Him Through

Employees who are cleared from the roll through lack of work or a reduction in force will receive their accumulated vacation credits as separation pay. This means, for example, that the man who has worked from June 1 to, say, April 1 and is laid off receives five days' pay as a separation wage. Separation pay to the man who is laid off is in many instances enough to see him through into another job without going into debt, or is enough in other cases to get him and his family back to the farm they came from, or to make other adjustment to tide over.

This, briefly, is the vacation and separation plan. The cost is definitely predictable. It is a substantial number of dollars, but not enough to affect the price of our cars appreciably. That is, if we had not put this plan into effect but had reduced the price of Packard automobiles, the reduction in price would have been so small that it would not have amounted to anything worth while. The cost of the plan, as already explained, has really been yielded by the savings in cost that have come about through the ways we have learned to cut costs without taking anything out of the product. And this is the ideal way, the only sound way, in which such a step can be taken toward betterment of the factory employee's treatment.

Our retirement allowance is entirely separate from the plans described above. We have occasionally seen the tremendous blow, both to a man's self-respect and to his finances, when he reaches an advanced age and cannot longer fill a factory job. This age is not uniform with all men; we have one man over 80 years who has been with us for 30 years and shows no signs of slowing up on his machine job. Other men, as we all know, cannot carry their weight at a much lower age.

Under our plan we are merely attempting to soften the financial blow. We have built up no reserves for old age pensions, cannot undertake them right now. But we do know that the man who receives a substantial sum of money, to be paid him as he requires it over a period of time, may have his adjustment to non-earning made much easier.

We have therefore decided to pay at retirement $25 per year of service as a special retirement allowance. The purpose is not to support the man whose working days are over. Obviously the allowance is inadequate to any such task. But it may, and already we have seen where it does, permit him to make necessary adjustments. For instance, one man who was retired under this plan had something above $700 coming to him. He had no savings, but he could go to live with a son in a city some hundreds of miles west of Detroit. He owed some money; getting to his son's home would cost something.

Individual Arrangements Are Made

Our purpose is to make an individual arrangement for payment in each case, to meet the individual's needs as best we can. This man took $200 at once, to pay his debts and his transportation. The rest he is getting at the rate of $10 a month, which gives himself and his wife some spending money and guarantees it to them for about five years.

Let me repeat that we have no illusions that our plans are perfect. We do feel, however, that our employees are far better off to have us make haste slowly and soundly rather than undertake some plan that might later throw our business out of joint and imperil their primary need—now being filled—for steady work at good wages. And we think other employers may be trusted to take steps in the same direction, though perhaps entirely different from ours.

Where Standards Set Are Standards Met

Only skilled workers can build a quality product like a piano. And skilled workers' hands would be tied without instrument and laboratory control

LEWIS K. URQUHART
Associate Editor

WHEN a plant works largely with natural materials of animal and plant origin, the problem of controlling quality may be materially more difficult than when the bulk of the materials are highly standardized. At the Baldwin Piano Company, Cincinnati, every effort is exerted to attain a degree of quality standardization comparable with the finest of metal working.

In the first place, the human factor is of unusual importance because of the high proportion of skilled hand operations necessarily involved in making a quality piano. Mass-production machinery is used wherever parts are required in volume sufficient to justify it. But inherently there is in the task a great deal of skilled work. A good piano is built, rather than manufactured. It is therefore essential that there be a large and steady force of highly skilled men—what a local paper, in describing this plant, referred to as "artists in overalls."

Instrument control has been found very useful in several departments. An excellent example is in controlling the drying kilns. When lumber is received, it is run through a laboratory determination for moisture content. This information, along with thickness and known density, is used to establish the schedule for exactly what shall happen to the lumber in the kiln.

Formerly lumber for drying was stacked on dollies merely with drying sticks between courses. It was then discovered that lumber from the outside of such a stack might be dried to determined standards while the lumber from the interior might be insufficiently dried. So it became standard practice to stack lumber on the dolly in a hollow square, with the size of the "air well" down the middle set by the dimensions of a ventilator head that must fit into it. How this affects control will presently appear.

Electric-motor controls on valves are hooked up with temperature recording instruments set to top and bottom limits, both wet- and dry-bulb readings. Therefore, when kiln temperature falls below say 120 degrees dry bulb, the inlet valve is opened and steam heat runs up the temperature. When it reaches say 140, the valve is closed. The recording instrument keeps a running record of exact performance.

Two-Way Air Flow

These instruments are in an instrument tunnel beneath the floor of the runway between the two facing banks of kilns. Blowers feeding the kilns are so set up that the air flow may be from the outside or inside of the stack. An instrument is set to reverse the air flow every two hours. Therefore the stack of lumber has its hot air draft from the outside in through the ventilator head for two hours, then for the next two from inside to outside.

Another control seldom exercised in woodworking plants is found in the physical and chemical laboratory. Constant determinations are made on all finish materials received from suppliers, to assure that they meet specifications.

Certain determinations are made periodically as a type of survey of available materials. For example, most glues have fats added to prevent excessive foaming in agitators. This is essential, yet excessive fat or the wrong kind of fat interferes with the strength of the glue. So the laboratory takes all the glues that are or might be used, stains them blue, paints narrow bands on a piece of wood. In each band, blue area is glue, white is fat. If there is not too much white, if it is widely distributed in tiny specks, then the glue is desirable.

Another determination steadily carried on is the breaking strength, both of test blocks of wood and also of test joints. The laboratory has developed its own testing machine, which gives a determination in pounds required to make the piece

fail. It is thus possible to determine when a shipment of lumber in undesirable for use in parts requiring considerable strength.

Inspection standards must be maintained at high level if quality is to be had. Parts turned out by machine in quantity lots are sample-inspected; the materials have, of course, already been passed as up to specification. There are numerous points in a piano, however, that can be passed or rejected only on the strength of actual performance when the instrument is played. So it is common occurrence to encounter an inspector working the keys to make sure their touch is exactly right, or another in a quiet room—even in a quiet corner—playing chords or plucking strings and making adjustments accordingly.

Incidentally, at one point where adequate quiet space was not avail-

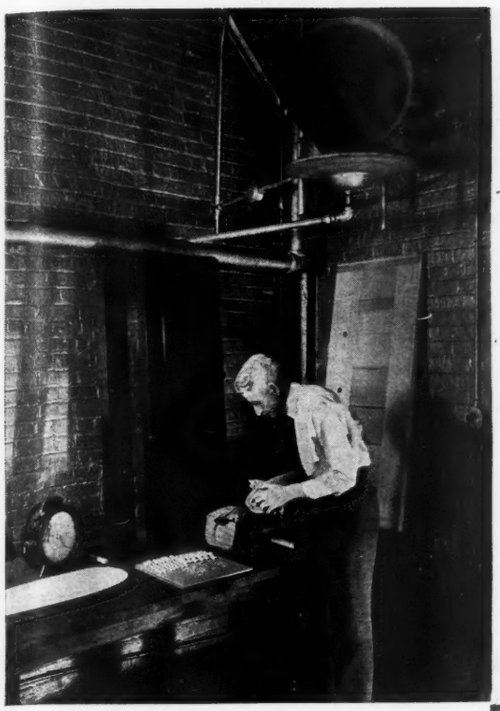
able, it has been provided in usable—if not ideal—measure by making cubicles of solid sound-resistant wallboard large enough to fit over a piano and a man. The piano is placed close to a wall and outside window, the oversized case is pushed around it, and the inspector has comparative quiet in which to inspect the tone of the instrument.

Tropical Room

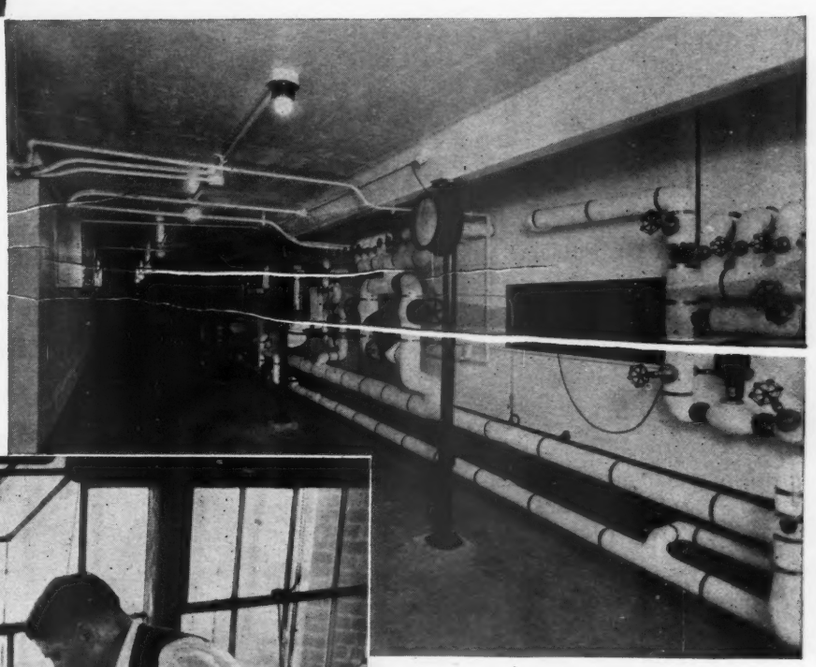
Another control which enables the factory to meet unusual climatic conditions is the experimental department known as the tropical room. Here it is possible to reach a saturated atmosphere, or even attain a fog when accelerated tests are desired. Likewise the room may be heated to any temperature a piano might be subjected to in the tropics.

Here are tested out the clearness required in action parts and other subdivisions of the piano to assure proper working in such a climate, say, as seacoast Central America. Under these conditions it has been found, for example, that some glue entirely satisfactory for use in temperate climates will give way in the tropics, or that certain joints must be left materially looser if the piano is destined to go to an abnormally wet climate.

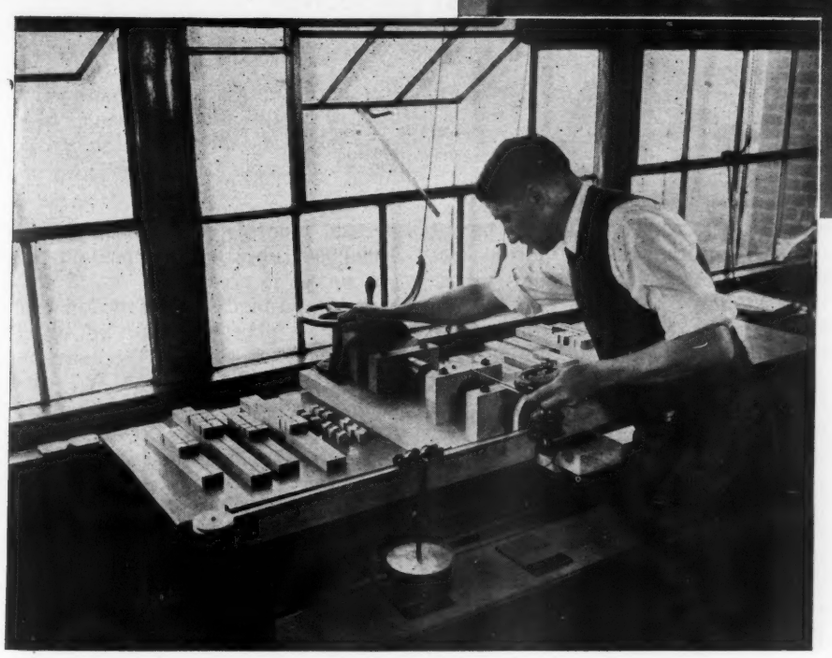
Preferable glues, preferable finish coatings, waterproof coatings, metals, panels, veneers, and so forth are all tested at one time or another. When a piano is to be shipped into a trying climate, its factory specifications are changed accordingly. Naturally enough, if a piano built for a banana town in Honduras is later moved to a high, dry climate like Denver, it will surely require some major adjustments to make it work properly.



Whenever the Baldwin Piano Company feels like simulating climatic conditions in, say, a Central American banana town—which it may want to do because some of its more important materials are seriously affected by the weather—it can do so in its "tropical" room

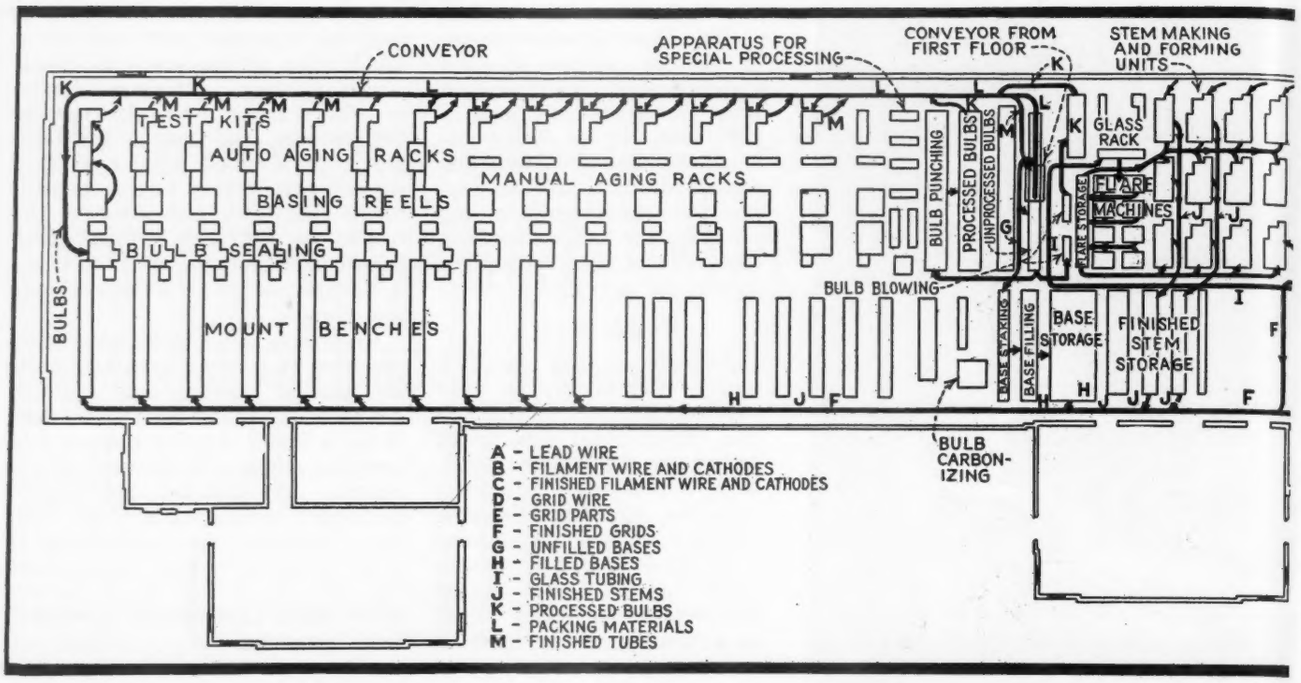


←Movable sound-resistant cubicles afford an approximation of quiet for inspection jobs that have to be performed in noisy parts of the plant. The open side is pushed up against an outside wall and windows. This booth had to be moved away to be photographed



Guesswork as to moisture content of lumber and desire for a quality product simply do not gee. At Baldwin, control instruments in a tunnel underneath the kilns regulate exactly what shall happen to the lumber

Final test of good glue is "How strong is its joint?" The laboratory has developed its own testing machine to determine how many pounds it takes to make a test joint fail



Built a Plant Around a Layout

Too often it's the other way 'round; the plant is built first and then the production layout has to be cut to fit the plant. The method described increases management's chances of getting lowest-cost production

F. J. HEALY
Works Manager, Hygrade Sylvania Corporation
Salem, Mass.

TUBES used in radio broadcast receivers consist, fundamentally, of a number of pieces of wire, glass, mica, small metal stampings, and so on. These elements are put through many delicate and exacting processes and assembly operations in which workmanship and various requirements are held to the highest standards. The result of a large number of operations and inspections is an extremely sensitive electrical device that sells at retail for the price of a few packs of cigarettes. How can it be done?

Many factors affect the manufacturing cost and therefore the selling price of a radio tube; one of the most important is the production layout. Unless machines and processes are arranged for maximum efficiency, costs cannot be kept at minimum level. That is why we built the new plant into which we recently moved.

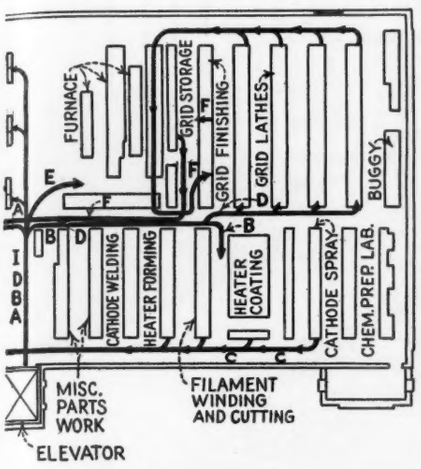
Back and Forth, Up and Down

For many years incandescent lamps were our only product. Growth of business resulted in a corresponding expansion of our plant by the erection of new buildings, or the purchase of adjacent plants. When the manufacture of radio tubes was started some years ago, it was impossible to obtain a satisfactory layout of the equipment. As output increased, conditions became worse, until at last production was flowing back and forth and up and down through a four-story building.

Meanwhile, as various improvements in tube manufacture were worked out we evolved a layout that was considered to be ideal. When the proper time came, we built a new plant around it. Before going further, it is only fair to say that if our production were either much larger or much smaller certain changes and rearrangements would be desirable, perhaps necessary. However, for our present monthly production of about 1,000,000 tubes of all types, our layout serves to perfection.

Taking a bird's-eye view for a moment, the plant building is 400 ft. long and 80 ft. wide in the main portion, and two stories high. Wings on each side house offices, laboratories, and other departments. The major portion of the first floor is devoted to incoming and outgoing shipments; materials inspection and storage; tube inspection, packing, and storage.

All tube manufacturing operations are performed on the second floor. Materials and supplies are delivered to it by an elevator and a conveyor



Second floor plan. Materials and parts are brought to the second floor by elevator and conveyor. Routes followed by raw materials and finished parts are shown by the arrows

located in the back half of the building. Fabrication and treatment of parts are conducted largely at this end. Parts assembly is done mostly at the other end; tube assembly and testing are carried on there and in the center of the area.

Many different materials and supplies come into the plant. Certain supplies, such as wire, mica, metal parts, factory supplies, and stationery, are delivered by trucks at the south side of the building. Such shipments are placed on a conveyor just inside the door and carried to the inspection department. All materials that pass inspection are sent on the conveyor to adjacent storage racks.

Portable Stockrooms

Foremen in the manufacturing departments are not required to requisition productive materials on which no process stock is carried. Instead, the stockroom issues to each department the required number of parts needed to produce the number of tubes scheduled for the second following day. Deliveries are made after working hours. Since the parts are light and small, they are loaded into rubber-tired trucks or buggies and taken by elevator to the second floor where the buggies serve as portable stockrooms, until empty.

Materials such as wire, from which parts are made and carried in stock ahead of assembly, are issued on foreman's requisition, but only a budgeted total for the week's schedule is allowed for each item.

Tube bases and packing materials, such as cases and cartons, are also received by truck. Because of their bulk these shipments do not go through the materials inspection department, but are taken directly to storage. There they are given whatever inspection is required.

Molded bases for the tubes and various other supplies are issued once a day in the amounts called for by the production schedule. They are assembled on a platform truck and carried on the elevator to the base preparation department.

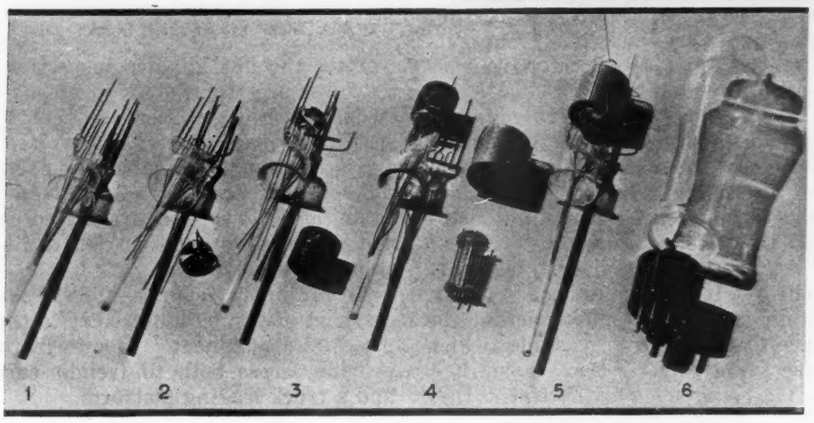
Tubing Hard to Handle

Deliveries made in freight cars consist of glass tubing and bulbs, and are received on the north side of the building. Tubing is unloaded directly into stock. A supply is delivered once a day to the manufacturing departments. Since tubing is difficult to handle on a conveyor it is loaded on a platform truck and taken to the second floor via elevator.

Bulbs are handled from the car to stock by portable conveyors, and are issued once a day in the same manner as the bases.

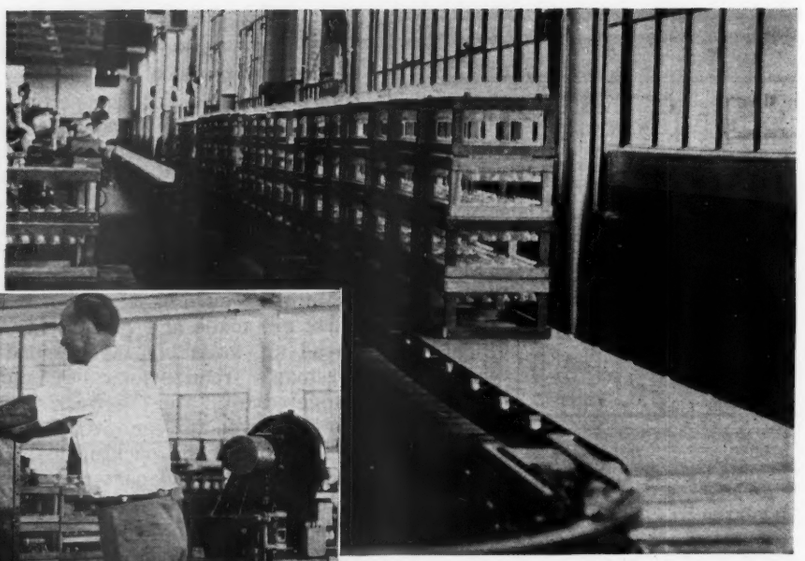
There are many types of tubes, involving marked differences in con-

All manufacturing and assembly operations are conducted on the second floor, which measures 400 by 80 ft. The mount assembly benches are in the foreground



Parts and assemblies that compose a radio tube: (1) unshaped stem; (2) shaped stem and collar; (3) stem and collar assembly, and plate; (4) stem, collar, and plate, with grid and cathode assembly, and outer screen; (5) finished mount; (6) bulb and base

Rubber-tired buggies deliver materials, parts, and sub-assemblies from the stockrooms to manufacturing departments, and between departments



A 240-ft., reversible conveyor along one side of the floor carries bulbs and packing materials directly to the sealing machines and testing benches. When reversed it takes cartons of finished tubes to the conveyor leading to the first floor which delivers them to final inspection

struction, which in turn affect manufacturing procedure. For this reason it would be impossible to make a layout in which all parts and assemblies moved in a straight line from one operation to the next. Therefore, it will simplify matters to trace the path of the materials and parts entering into one type of tube only.

After delivery by elevator to the second floor, certain metal parts of the tubes, such as collars, plates, and screens, are taken directly to furnaces in which they are heated to a high temperature in an atmosphere of hydrogen, to drive off occluded gases. After this treatment they go to the assembly department.

Some Day, Conveyors

Grid wire is taken directly from elevator to grid lathes. After winding, the grids are passed through the hydrogen furnaces; then to finishing benches and into storage cabinets. It is planned eventually to conveyorize this process.

Filament wire and cathodes go directly to the coating department, where they are processed and stored in heated cabinets, ready for delivery to the assembly department.

Glass tubing, on platform trucks, is taken from elevator to glass racks serving the flaring machines, whose output goes into nearby storage racks before being distributed to the stem-making machines.

Finished stems are stored in racks adjacent to the stem-making units, and delivered to the mounting benches with the other parts.

Twice a day enough of all these parts to meet one-half of the day's schedule is taken from storage in the various departments and delivered in buggies to the mount assembly department at the other end of the floor. Here they are placed in the supply racks at the end of each mount bench. These deliveries are made during the noon hour and after closing time.

As bulbs come up from first-floor storage they are piled directly in back of the conveyor. Machines that perform the three required processing operations are supplied from this reservoir, and are located conveniently around it.

A belt conveyor 240 ft. long running along the north wall delivers processed bulbs at regular intervals to the sealing machines. Here finished mounts are sealed into bulbs and the latter evacuated.

As mentioned previously, bases are delivered to the second floor by truck. From it they are moved across the aisle to the staking machines, which insert the prongs, then to storage. After being filled with cement they are delivered twice a day, in buggies, to the basing reels. In these machines, bases are fitted to tubes.

The final operations in tube manufacture are soldering of the lead wires to the prongs in the bases, assembling and soldering of the top cap, and aging or seasoning by electrical treatment on a rack having a socket for each tube. The finished tubes are then passed along to the testing benches a short distance away, where they are given complete electrical tests and inspected visually. Tubes are then packed in cases for storage.

Packing materials are delivered at noon and at night directly to the test benches, by the long conveyor referred to above. Except during bulb deliveries, when its direction is reversed, the cartons of finished tubes are placed on it and carried to the conveyor running between the first and second floors. From this point they descend on the latter conveyor to the quality inspection department, where a certain proportion of the tubes are given another careful test and inspection.

Then to Finished Stock

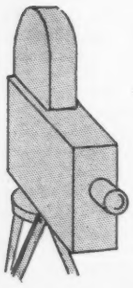
After the final quality inspection, the tubes are transported to finished stock, which is adjacent to the inspection department. A few feet away are the packing benches. As tubes are packed each one is tested again, and the cartons are placed on a roller conveyor and carried to the shipping department.

The shipping department is at the east end of the building, next to the packing department. Doors in it provide access both to freight cars and a truck loading platform.

Detroit Creates New Skill

Apprentices this year. Highly skilled workers next year or the year after. Maybe foremen 10 years hence. Detroit builds for the future, has enlisted 74 concerns, large and small, in a training program which aims eventually at turning out some 3,300 skilled men a year

Part of 1936 class of apprentices at Murray Corporation of America. Above, apprentice model maker at Fisher Body Corporation; toolmaker at Hudson Motor Car Company



Motion Camera Uncovers 34 Per Cent Savings

RAYMOND E. SMITH
Manager

and

WALTER A. REINHARD
Industrial Engineer
American Institute Laundry, Joliet, Ill.

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WHEN the American Institute Laundry became interested in the possibility of applying motion study to laundry operations, it analyzed a number of operations to see whether or not they could be improved. The laundry not only does a commercial business but also serves as a demonstration and training plant for the members of the Laundry-Owners' National Association. As such, it is constantly investigating new equipment and receiving the benefit of suggestions from practical laundrymen in every section of the United States.

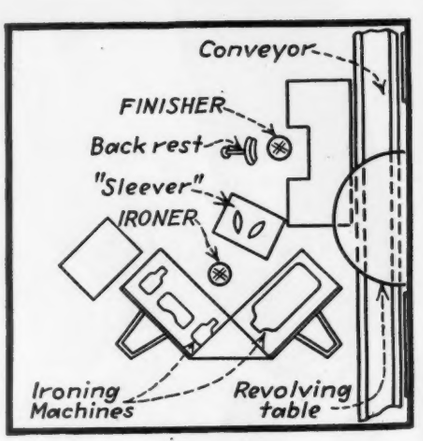
34 Per Cent Less Time

The first operation selected for study was the finishing of shirts, which keeps about 15,000 women and girls busy day in and day out, throughout the country. Presumably, with its special position in the industry, practice at the Institute Laundry was not appreciably behind the best practice then in use, but it was found possible, by rearranging the process at slight expense, to reduce previous time by 34 per cent.

A motion camera with an f:1.9 lens, geared to a motor that exposed 1,000 frames per second, was used with photo-flood lighting, both because of the unapproachable accuracy for study given by the film and of the value of this permanent, detailed, and pictorial record in demonstrating and teaching the new methods developed. The film record thus obtained of the old operation was analyzed and a simo-motion chart was constructed. This chart was then studied, in the light of the principles of motion economy, to see which elements were unnecessary and could be eliminated. A possibility chart was constructed, showing what might be expected.

THIS IS THE JOB THAT WAS STUDIED

General view of ironing operations. Girl at right takes shirt damp from wash and irons front, back, and collar. Then she pulls sleeves over steam-heated "sleever" and leaves shirt there. . . . Girl at left is the finisher. It is her job that is being studied. She irons cuffs, shoulders, folds shirt over cardboard stiffener, secures it with paper band. Belt conveyor removes filled boxes of finished shirts. Revolving table transports shirts to repair section and back again. At right, layout of new method



The operation was then reconstructed. The final sequence of motions did not by any means appear full-fledged from the first study. A good deal of experimenting was done; at one time the old method was demonstrated before a group of interested engineers, and their suggestions were recorded in detail. While the actual development was thus largely a matter of experiment, the chart analysis pointed out the places at which to look for improvement. That is half the battle when you are so familiar with an operation that you can see no way to improve it.

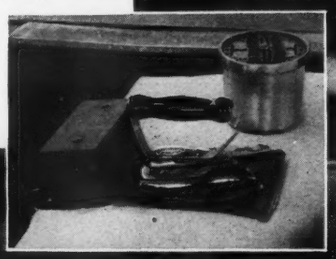
Most of the changes were perfectly obvious once they were made.

THESE PARTS WERE IMPROVED

Below, laying out the shirt. Formerly the finisher laid it lengthwise of the board, had to fuss a lot to straighten it out for ironing. . . . Recess cut in board now allows tails to drop out of way, whereas sleeves, neck, and shoulders lie in semi-circle before operator, in efficient working area. Operator soon learned to drop shirt in place with single movement of arms, elbows, and body

Operator used to dampen and iron a sleeve, then a shoulder, and so on, picking up and laying down dampening cloth and iron each time. . . . Now she starts at right cuff, dampens around circle from left to right, irons back from right to left. Then she puts down iron, turns shirt, and repeats process

Small photograph shows cloth dampener and cordless iron. Latter weighs 3½ lb. instead of 6, heats between uses through special contacts on stand. There is a stand on each side of workplace so that operator can lay down iron in same place where she picks it up for next ironing operation



Final folding of shirts (above) is far easier. Operator really needed three hands to hold sleeves and tail in place and slip on paper band. Now, at critical moment, little arm made of ¼-in. pipe fittings, is depressed by foot pedal. It holds everything, flies back out of way when shirt is done

Not all details can be shown in these few pictures. For example, space limitations forbid reproduction of instruction sheet in which operation was minutely described for instruction uses. . . . One question asked was whether operator could be seated. Seating proved impracticable, but back rest (see general view of operation, also floor plan) affords change of position, takes load off girl's feet for part of each cycle

Process chart (below) shows exactly how time for complete cycle was reduced 34 per cent, and production rate was increased from 36 to 55 shirts per hour

HERE IS THE RESULT

Simplified Elements for Comparison	Methods of Shirt Finishing	
	Old	New
	Sec.	Sec.
1 Reaching for Shirt, Turning Collar, Buttoning Collar Button, Carrying Shirt to Table	10.68	8.15
2 Setting Collar, Buttoning Shirt Buttons and Smoothing Shirt Front	6.54	3.54
3 Picking Up, Laying Down or Adjusting Shirt in other ways to aid ironing	8.04	3.68
4 Reaching for and Moving Dampening Cloth to and from Shirt	5.34	2.14
5 Total Dampening Time	13.02	10.79
6 Reaching for and Moving Iron to and from Shirt	7.26	2.21
7 Total Ironing Time	24.6	19.8
8 Folding Shirt	21.5	12.76
9 Carry Shirt to Box	1.74	1.86
TOTAL	98.72	64.93
Production Rate Per Hour	36.45	55.5

But it is not until you begin to study the small elements of motion, too short to be caught with a stopwatch or even to be noticed by the untrained eye, that you become aware of these small wastes, so obvious once they are detected.

The method as finally developed, together with various other applications of motion study to typical operations, are now being taught to employees of members of the Association. The motion picture projector has been found most useful in this teaching.

You want to know

and the editors will gladly tell you more about the things mentioned on this page

• "DOES Unionism Really Benefit American Labor?"—study of income and employment security in unionized and non-unionized industries is summarized in a booklet. Take or leave its conclusions, it has some interesting figures. (11601)

• SPRAY NOZZLE for heavy washing operations can be supplied with ferrous, brass, bronze, or nickel head, and for 2- to 3-in. pipe. It has no threads at the joints, can be quickly detached and reassembled. (11602)

• FIREPROOF CLOTHING, made from fabrics of woven asbestos, and dyed in colors, is reported from England. They've made mechanics' overalls, cooks' aprons, decorative curtains from it. Looks as if it had many other potential uses. (11603)

• RUBBER PAILS, unaffected by acids and corrosive chemicals, can now be had because a new rubber-casting process has been developed. They're reinforced with stainless steel and have stainless steel handles. (11604)

• WINTER'S coming and concerns operating trucks will have skid chain expense once more. There is a new device for repairing broken chains quickly and cheaply. It's said it won't gouge holes or injure the tire in any way. (11605)

• YOUR RECORDS are invaluable; you can't take out any sort of insurance that can restore them once they've been burned up. Proper protection is the thing. An 88-page manual tells how. (11606)

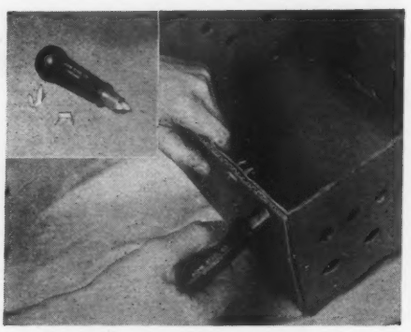
• MILK can now be frozen without injuring its properties. New process first concentrates the milk, then freezes it. The milk can be kept for weeks, it is said. (11607)

• HEAT-TREATED GLASS has been used to make an all-glass gasoline pump. Orange gold color is fired on the inside to give both day and night color effects. (11608)

• FINISHES for aluminum are described in a booklet, with illustrations, to show effects obtained. Mechanical, chemical dip, electrolytic oxide, paint, lacquer, and enamel finishes are covered. (11609)

• COMPUTE payrolls, job costs, federal and state taxes under the social security act with a new calculating machine for which great speed and simplicity are claimed. Subtracts and multiplies in one operation. (11610)

• SPECIALTY CHEMICALS, now in commercial production, are described by their manufacturer in a booklet. The physical properties are listed as are suggested uses. (11611)



YOU can't see it, but in the handle of this carton stapler there's a strong spring that drives staples through several thicknesses of corrugated board. Stapler is less than 5 in. long, has molded plastic handle (11623)

• IF your recording meter charts have only daily value, and are discarded after the day's run, you'll want to investigate a new chart that will last three years under normal operating conditions. It has a smooth, hard surface from which pen recordings are removed with a damp cloth. (11612)

• THEORY and application of a resistance welding is subject of a booklet that covers methods and machines, transformer capacity and pressure requirements of spot welders, data for butt and projection welding, design for projection welding, selection of electrodes, spot welding of coated sheets. (11613)

• REMOVAL OF ODORS is an important function of air conditioning systems. A pamphlet describes coconut-shell-carbon odor adsorbers. (11614)

• COTTON DUCK, fire-resistant, will not ignite even when exposed directly to fire, it is claimed, and its properties are not destroyed by water or the elements. You can buy either the processed material or the compound to apply by brushing or spraying. (11615)

• DRUMS and other shipping containers with stainless steel interiors, in capacities of 10 to 110 gal., are designed for food products, acids, solvents, other corrosive materials. (11616)

• ETCHING PENCIL, electric, writes on steel. It's a process of arc welding, the tip of the pencil vibrating to permit the miniature arc to be interrupted and produce the etching effect. (11617)

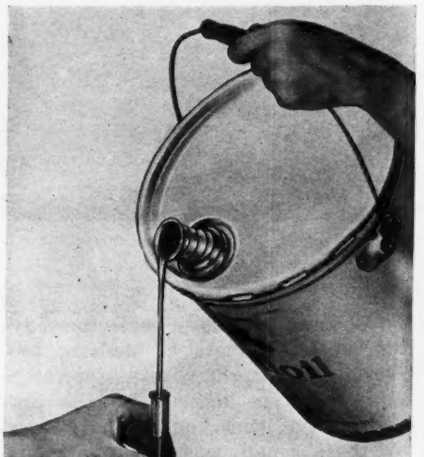
• FOR THOSE WHO don't know a great deal about electricity and electrical equipment, and who need a bit more working knowledge, there's an excellent 48-page booklet. (11618)

• HYDROSTATIC GAGES for paint mixing tanks measure weight of lacquer and thinner added. This means any one viscosity can be matched time after time. The gage indicates liquid level also. (11619)

• NEW EDITIONS of the National Board of Fire Underwriters regulations for foam extinguisher systems and for installation of sprinkler equipment have been published. (11620)

• PHILATELISTS will tingle with the joy of treasure found when they see a new stamp magnifier which enables them to inspect and measure a stamp's details. It's a neat molded plastics job, black in color, with scales and lettering molded in. (11621)

• ANOTHER REMINDER that winter's on its way is announcement of a plow for removing snow from factory yards and runways. It can be attached to any power-driven lift truck, has blade 54 in. long and 24 in. high. (11622)



TO SOLVE an annoying, often messy, problem, this telescoping spout for 5-gal. cans is made so that its edge projects over the side of the can, permits pouring of stream from few drops to full spout capacity. With it comes a tight-fitting cap (11624)

Conveyer Assembly Keeps a Plant on Its Toes

Sets pace for whole factory, controls production as it never could be controlled in bygone push-and-pull days

ARTHUR VAN VLISSINGEN, JR.
Consulting Editor

UNTIL last November, diesel engines at Caterpillar Tractor Company's plant in Peoria, Ill., were assembled on a line where the individual motor blocks were mounted on dollies and pushed along by hand from station to station. It was entirely feasible for precision assembly, since the dollies traveled along a two-rail track and the engines were firmly positioned at all times. But it was decided that a mechanically moved conveyor would do the job better, and one was laid out in another building to which operations were transferred.

Labor Saved

Results have been startlingly successful. Savings in direct labor—the principal objective in making the shift—have been disclosed as of secondary importance. The labor has been saved, all right, justifying the installation, but the big saving has come about through the effects of that conveyor, extended all through the diesel engine department and all departments that feed it, from the most distant and apparently most insignificant sub-assembly or machine operation right on through the engine assembly itself.

"While the old line was operating, a man was supposed to perform his operation and then push the work along," explains the production executive in charge of the plant. "Whether he actually did his job on time, and pushed it along to the next station, was pretty hard for the foreman to control. What happened was that a good many jobs stayed too long at one station; then everybody hustled in an effort to catch up—which was sometimes successful and more often not. In brief, production was by fits and jerks, and no matter how competent the foreman in charge of this line might be and how hard he might try, he could not know precisely what was going on at any time. It was almost impossible to trace all causes of delay.

An assembly line foreman moves the controller up another notch, and the speed of the 300-ft. diesel assembly conveyor is increased

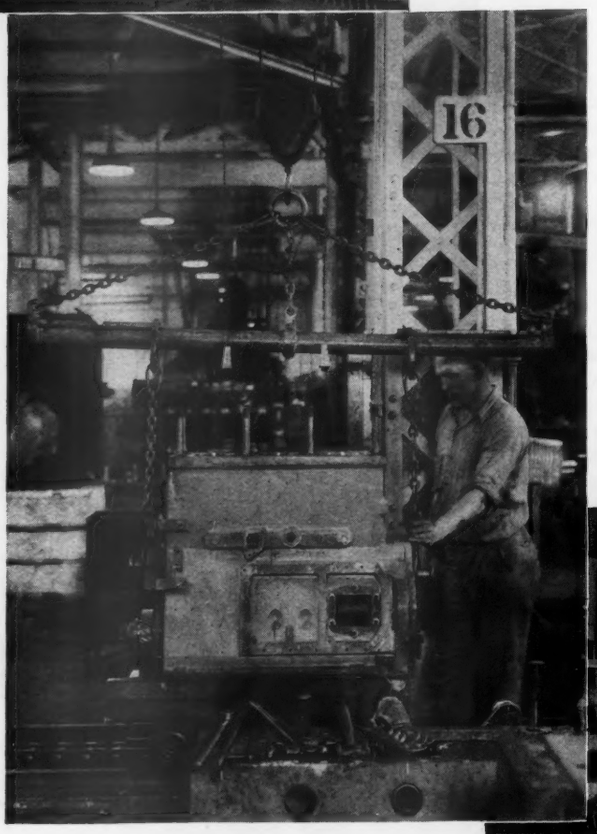
Fewer Shutdowns

"When we put it over on the moving chain, that all cleared up as if by magic. The assembly workers had to keep producing steadily, otherwise the man who was behind with his work was revealed by the fact that he would be working away from his station. The feeder lines and departments had to keep the stuff flowing, because if they did not they would be responsible for shutting down the new line. Every foreman in the organization was determined that he would not be caught doing this, so he got all his work organized to prevent any slip-up.

"We had a record all set up in advance, by which every shutdown of the line would be duly reported, in the expectation that we would find that there were certain chronic offenders. After the first ten days we threw this record away. There weren't any offenders. In five months the line has been shut down five times for lack of material, and then only for a few minutes and for excusable reasons, with no two shut-downs attributable to the same department.

"What the diesel engine

Diesels ride on dollies on this 300-ft. mechanically moved assembly line. Engine at extreme left is about to be lifted off the line and moved to run-in blocks



Handling equipment built to meet the need. Engines at this point are revolved from horizontal to vertical position. The notched ridge along the top of the pipe is designed to accommodate different engine sizes

To raise men to a convenient work level and to keep them there without falling off, there is this platform backed up by bins, tiered skids, and piled parts. At this point the platform is about 12 in. above floor level. Operation in the foreground is installation of fuel injection lines

assembly line did, then, was to tone up the morale of the entire diesel factory. The ever-moving line somehow caught the imagination of the key men and the rank and file. They saw—as they had never been able to see with the old push-pull line—themselves as part of the mechanism that gears right into this final assembly operation. And they improved their own work accordingly."

There are two major reasons why the Caterpillar diesel assembly line is unusually worthy of comment. In the first place, a diesel engine must be a precision product. Tolerances are narrow, work must be exact. In the second place, "Caterpillar" makes a sizable variety of diesels, from a big six-cylinder job down through a three-cylinder of the same type, and an even smaller four-cylinder job.

All these diesels, the six and the big four (in two styles, one for tractors, one for road machinery power units) as well as the three and the little four, are assembled on the single assembly line. For good measure, a small four gasoline engine, very similar to the little four diesel, is assembled on the same line. There are, likewise, the tractor and power unit types of the two small fours. These are all done simultaneously. At one time, therefore, the line may contain all kinds of engines, with no apparent rhyme or reason in their sequence. These varied products go through with complete smoothness, and with an unbelievable lack of red tape—just why will be explained a paragraph or two further along.

Theoretical difficulties of precision assembly are overcome by the conveyor line design and by the layout of the many operations. The conveyor line is composed of an endless link chain running between two narrow gage rails. This chain has four speeds, which are used according to the scheduled production and the number of stations in use along the assembly line.

The chain moves smoothly, and the rails give smoothness and solidity beneath the work. Consequently it has been found entirely feasible to perform on this moving line any precision operation that the assemble requires. This is largely a question of personnel, of having the right man in the right spot. For instance,

when the line was first in operation, the man who performed the most precise hand operation on the line was unable to keep up, on production of twenty-odd engines per day. He was shifted to another factory job, and the job was given to a man who had demonstrated considerable speed at another precision operation in another department. This man handled the job comfortably, and as production has climbed above 50 engines per day he has easily kept up with it. His predecessor could not maintain the requisite precision on half of this production.

The problem of variety of engines assembled on this line is handled with utmost simplicity. The only paperwork or planning—in the usual factory sense of the word—is a daily list which comes to the foreman retailing how many of each type of engine he is to turn out. Departments ahead of this line are likewise notified, so that the day's supply of machined blocks may consist of the right number of each size.

Simplification a Big Help

Primarily, the difficulty has been resolved into no difficulty at all through simplification of design. The three larger diesels—the six, the three, and the big four—all have the same bore and stroke, therefore their cylinders, pistons, and other parts are identical. The two little fours, one a diesel and the other a gasoline job, are identical up to the point where if it is to be a diesel it receives a fuel injection assembly, and if it is to be a gasoline engine it does not. The tractor engines and road machinery power units are, to cite another example, identical in all but a very few respects.

There are, then, from the assembling standpoint, just two major varieties of engines, the big bore and the little bore. In many repects—the timing trains, for instance—all the big-bore engines are identical, use identical parts and sub-assemblies. It may be said as a general rule, with a very small list of exceptions, that all the engines are, for assembly line purposes, in all but a few respects identical beyond the cylinder specifications and number of cylinders, and that the variations in assembling come about through these two differences, chiefly through the different number of cylinders.

A Simple Expedient

The expectable complexities of assembling have, therefore, been largely forestalled through simplification principles in engineering design of the product. Additional planning beyond the tiny amount already mentioned is avoided by the simple expedient of keeping on hand, adjacent to the engine assembly, an adequate bank of all the small parts to fit all engine sizes. Assembly workmen have at each station cards showing which part to use on each kind of engine, and they memorize these so quickly that they are no longer referred to except when a new man comes on.

For the larger, more complex parts which vary with the kind of engine, the problem is handled by making up this piece to order right alongside the engine assembly line. Piston assembly sets, for example, are made up by a man working only a few feet off the line. When he makes up a set and racks it, he places the rack alongside the engine line for the use of the assembler. At the same time, the piston man takes a look at the line, sees what the next engine will be—the differences can be discerned at a glance—and makes up his next set accordingly.

The man who makes up the overhead valve assemblies works in the same fashion. Even here there has been simplification, since the six-cylinder engine requires two of the three-cylinder assemblies, but with a shaft reversed. At several points along the line are these stations where a subassembly is made to order, but the only order used is the subassembler's quick look up the line to see what type of engine he must make up a part for.

When the block first comes to the engine assembly line it is brought over from the water-testing station on a small floor-controlled electric crane and set on the dolly. The dolly, it should be explained, is firmly attached to the moving chain, so that when the chain returns upside down beneath the conveyor housing (which is flat on the floor, being sunk only to the depth of the end-grain floor blocks which were removed to accommodate it) the dolly goes with it. To accommodate these dollies, the chain at head and foot of the line passes into a small pit, passes over two eight-foot pulleys, then returns to floor level.

The dolly is a steel platform (3 ft. by 4) mounted on a swivel so that it may be turned in the horizontal plane. The plate is locked into position and may be released by a foot trip from either side of the line; two trip levers are provided for convenience. At various stations along the 300-ft. line where it becomes desirable to change the side of the block nearest to the worker, this is easily accomplished by the pivot.

First operation on the assembly line is to take off the main bearing caps, shells, and shims, and remove by hand any small burrs which may have accumulated in process. Some of these are then replaced, the balance are rested on top of the casting to ride until needed farther down the line. The next operation is installing the oil lines; then comes the blowing out of cylinders, oiling system openings, bearing surfaces, and so on. Next the crankshaft goes in—purely an assembly operation, for the bearings have been line-bored and no hand fitting is required. Thus the work goes, until all operations along the bottom and side of the block have been completed.

Taking Out the Complexities

It is now necessary to change the position of the engine by rotating it in the vertical plane. An air-hoist is hooked to the engine block and sets it upright—another example of how to take the complexities out of a multiple-product assembly line.

A below-the-hook device on the air hoist is a marvel of simple effectiveness. Three chains enter a ring over the hoist hook—one chain to each end of a pipe bar, the other to the middle. The pipe carries two rings from each of which suspends a chain ending in a ring. These rings hook over lugs fitted into each end of the engine. But the engines are of four different lengths, and the hook-on needs to be straight up and down. So the pipe above carries a

(Continued on page 76)

Strategy Says Six Stockrooms

So six there are in this plant, each located right handy to the production lines it serves. But that's where decentralization ends. Control of all six is firmly vested in a single production clerk

A. B. JACOBS
E. & T. Fairbanks & Company
St. Johnsbury, Vt.

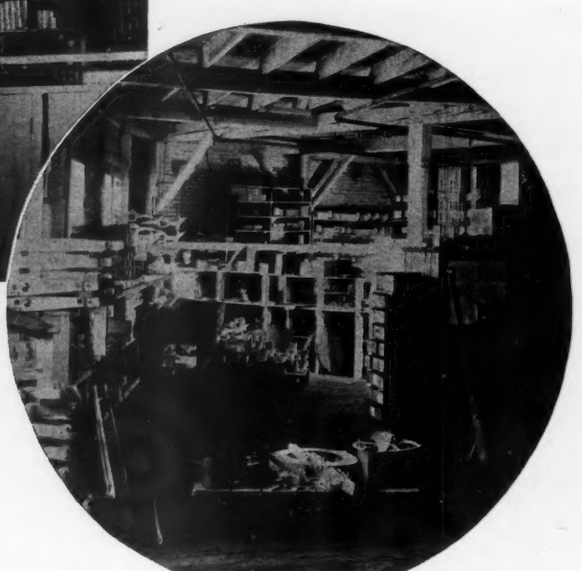
IN A plant that manufactures hundreds of different products it is extremely important to have well-arranged stock rooms strategically located with respect to the various operations performed.

Our company began making scales on the present site in 1830, and the plant now comprises several buildings with a floor space of some ten acres. Scales made range from those for weighing infants to those for weighing 500-ton mixes. Obviously different types of scales must be made in different parts of the plant, yet certain parts are interchangeable for many types. Consequently parts must be stocked for convenience and efficiency in handling and in such a manner that a perpetual inventory is available.

Near Departments They Serve

There are six stockrooms, each situated with special reference to the departments they serve. The first of these is the storage for purchased bar stock, mostly high-carbon steel used in pivots and bearings. This is located adjacent to the railroad siding for convenience in unloading. The material is placed in racks and marked according to grades.

The storeroom for rough castings is perhaps the most interesting and certainly the most elaborate.



Above—Storeroom located alongside assembly floor for counter scales. View from assembly floor and (at top) inside view showing steel shelving. Right—Stockroom for parts for heavy dial scales. Skids loaded with parts are taken to assembly floor by lift truck

Some 30,000 different kinds of castings are accommodated here. Cast iron castings are delivered from the cleaning room and brass castings from the brass foundry, either by gas truck or hand truck. Every casting has its number cast on so there can be no mistake about its identity, and bins are provided for every pattern number, except that the large ones are stored in bays on skid platforms.

A third stockroom is provided for finished parts for certain of the portable scales and for scales that are set in the ground. In the fourth are stored parts for the various dial scales—portable, bench, and full capacity types. Finished parts for counter scales, personal scales, infant scales, and so forth are stored in the fifth stockroom. These are all situated convenient to the assembly departments for each of these types. The sixth stockroom is for purchased materials other than steel. Each is designated by a number.

Now let us consider how the production department functions with respect to these stockrooms. It will be apparent that they play a very important part in the efficient operation of the plant. When orders come in they are sent to the order department, where they are made out in triplicate (Figure 1). One copy is held, one goes to the production department, and the third is sent to the foreman of the department that assembles the particular scales in question. The foreman gives the order a shop number which identifies it so that repair replacements can easily be made whenever occasion arises.

The production department, however, controls every order that goes into the shop. When it receives its copy of the order a clerk makes out a list of the parts required (Figure

(Continued on page 77)

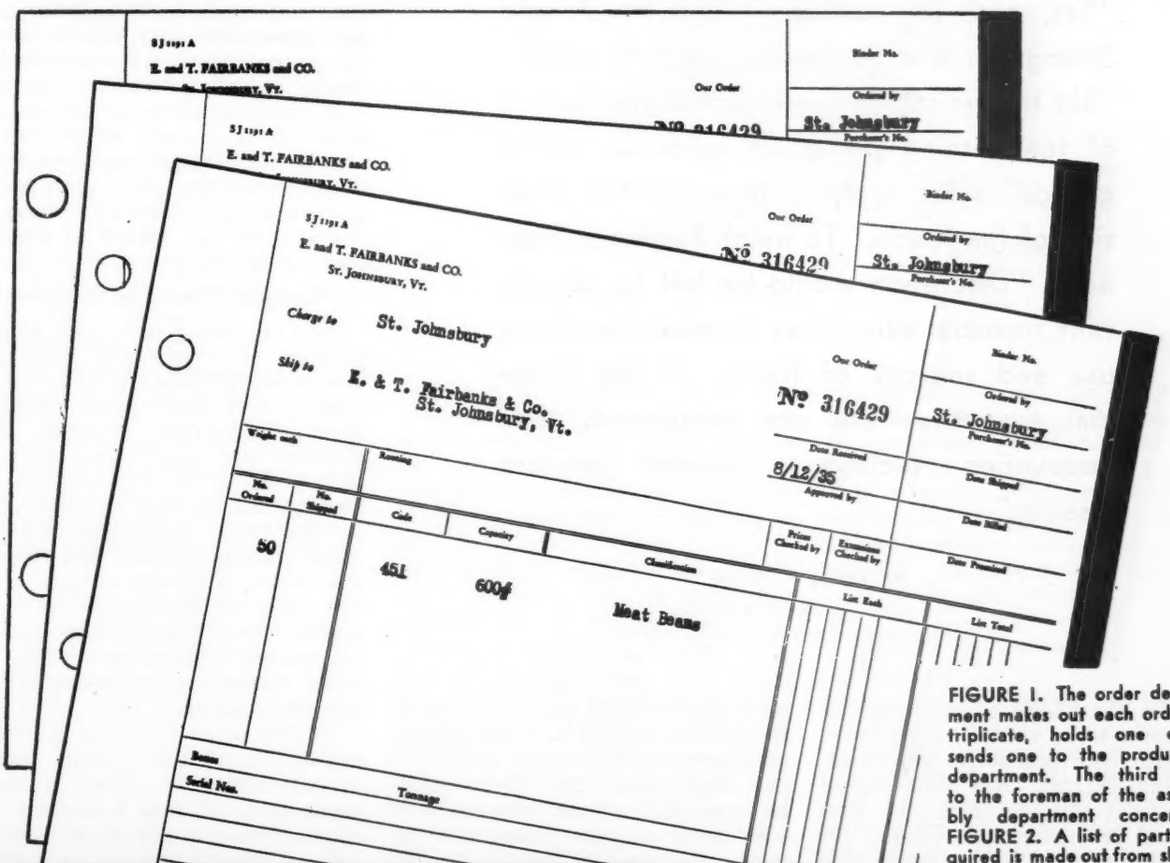


FIGURE 1. The order department makes out each order in triplicate, holds one copy, sends one to the production department. The third goes to the foreman of the assembly department concerned. FIGURE 2. A list of parts required is made out from sheets supplied by the engineering department. FIGURE 3. For each part of each scale, a card to serve as a perpetual inventory. Cards are filed in "tubs" and are instantly available

"T" 5/24/32 "T" 11/31/30 REVISED
"T" 5/26/35 "T" 11/12/31

FAIRBANKS SCALES MANUFACTURING LIST

900 LB. CAPACITY BUTCHERS MEAT BEAM WITH ALUMINUM DIE CAST BEAM — CODE NO. 451 — 2 SHEETS 2

PLAN NO.	TITLE	QUANTITY REQUIRED	SYMBOL NO.	MATERIAL	REMARKS
A 47816	OPEN CONNECTING LINK	1	MT 8 D	STEEL WIRE	PAINT
"B" C 58008	BOTTOM BEAM - DETAIL	1	MT 136 D	ZINC CAST	CAST FROM MT 136
	GRAD. 50 x 1/2 LB.				GRIND AND POLISH
"A" A 20284	LOAD AND FULC. PIVOT	2	MT 40	CRUCIBLE STEEL	
A 46139	TIP PIVOT	1	BM 40	COLD DRAWN HIGH CARBON STEEL	
A 19478	FRICTION STEEL	3	PA 43	CRUCIBLE STEEL	
A 24452	LOAD AND FULC. LOOP	2	DYK 39 D	M. C.	PAINT
A 588	TIP LOOP	1	MA 39 D	M. C.	PAINT
"B" B 58041	BOTTOM POISE - SEALED TO WEIGH 60 OZ.	1	MT 608 D	C. I.	C. P. & POLISH -
"L" A 57889	SWIVEL HOOK	1	JH 94	M. C.	B. B.
B 20878	MEAT HOOK	1	MT 512	M. C.	B. B.

Symbol DYK 39D Material MC Weight
Name Loops
Drawing A 24461 Finish Green
Max. Min. Sec. Bin
No. Pieces Code No. 451
Routing 66 - 80 - 41 - 50 - 59 - 80 - 66

Date	Order No.	Pcs. Ord.	Rough Cast	B. C. Appr'd in Ord.	Pieces Starting	Pieces Finished	Finished Pcs. Appr'd on Orders	Pieces in Output	Pcs. in Shop's	Pcs. Lost or Scrap
8/7/35	27948				200					

Cash for Plant Replacements?

"Yes, cash in the bank," said H. Arnold Strangman in a September Factory article. "But that results in unwarranted sterilization of the earning power of funds so segregated," is the reply of those on the other side of the fence. To which Professor Fiske adds, "Discretion should be left to competent financial executives to plan the wisest use and sources of funds. If the financial executives are not competent, then accounting techniques cannot prevent disaster"

WYMAN P. FISKE
Associate Professor of Accounting
Massachusetts Institute of Technology

THE PROBLEM of plant replacements is of extreme importance, with both production and financial implications. Any discussion of plans that will eliminate the necessity of deferring replacements for financial reasons is worthy of serious consideration. In the September issue of *Factory*, Mr. H. Arnold Strangman restated in a particularly apt and readable article the suggestion that funds equal to the amount of the annual depreciation charge be segregated and earmarked to be used solely for replacement purposes. This position is taken by many serious-minded business men and engineers. Opposing them are those who hold that the policy is an unwarranted sterilization of the earning power of the funds so segregated since "cash is tied up in an ever-increasing amount."

Here again is a conflict of principles and, as is so often the situation, a case where each principle is right when applied to a limited set of conditions, but where neither is universally applicable. The particular experience of the proponents of each point of view frequently explains the position taken. At the same time, unless conditions in my plant or in your plant approximately coincide with those of one side or the other, the arguments are productive only of confusion.

As to the fundamental relationships there is little difference of opinion. In spite of much loose terminology, business men are substantially correct in feeling that the balance sheet includes assets equal to the reserve for depreciation. (The assets are really substitutes for the plant used up in operations rather than an offset to the reserve for depreciation, but the effect is the same.) Depreciation charges, like other expenses, serve to mark a portion of the sales receipts as necessary to replace an outlay made in connection with sales; so long as the profit and loss report shows a net income, or at least a break-even, assets will be retained sufficient to replace the dollar value of plant capacity used up in operations. The sole problem, and this is admitted by both sides, has to do with insuring the presence of assets of the right type at the right time.

Obviously, if all cash received is used immediately to buy additional units of plant or to pay debts, funds will not be available to replace old units when they are retired. Segregation of funds for this latter purpose appears an easy way to insure the desired result. The proposal is similar in nature to tax or vacation club plans under which sums are deposited from each week's pay to provide for a tax bill or for a vacation expenditure. The plan seems so obvious that those who object to it are under the burden of proving their contentions.

Consider These Two Extremes

Once the *prima facie* logic of segregation of replacement funds has been accepted, progress can best be made by consideration of the replacement characteristics of plant. Two extremes are conceivable, although neither can be found in practice. At the one end there is the plant that is like the "wonderful one-hoss shay." Replacement of this remarkable vehicle was required only at the end of a hundred years and supposedly there were neither repairs nor partial replacements in the interval that elapsed between construction and collapse.

At the other end may be found a plant composed of a large number of like units of relatively small value each. If such a plant is constructed over a period of years, it will ultimately require replacement of individual units at a uniform rate year after year; the time never will come when the entire property must be replaced all at once, unless a new and radical invention produces complete obsolescence.

All types of plant have one or the other characteristic predominant. Buildings ordinarily come nearest to the "one-hoss shay," while small tools used by a contractor perhaps come closest to the other extreme. The replacement characteristics of any plant in total depend upon the relative proportions of units of each characteristic. An electric generating station with a

(Continued on page 78)

If the worker only knew

Wouldn't he see that wages must depend on production?

"IT SURE gets my goat, Ed. I don't think that guy knows what he's talking about."

Big Ed and Sam, planer hands, were walking home from a lecture at the foremen's meeting to which they had been invited.

Sam went on: "First he tells us that good times depend on purchases of industrial and farm products. Then he says the ordinary people like us buy much more than the rich. And then he says if wages went up in a big jump purchasing would go down. I don't get it. To a brain-truster like you I suppose it's easy."

"Don't call me a brain-truster, just because I do some reading and studying. It's not easy, Sam, but I think I do see the light. Maybe I can help make things clear. Now the first thing—you agree that if the goods industry turns out aren't bought, there's no use making them, don't you?"

"Yeh, that's right."

"And the same thing is true of farm products?"

"Yeh."

"All right. And you admit that there are many more ordinary people like us than rich people?"

"Yeh, that's right, too."

"So that means even though a rich may may have up to half a dozen cars, most of them have to be bought by us ordinary fellows, because there are so many more of us."

"I admit it, Ed, and I see the same is true of other things that are made, and the stuff grown on the farms, too."

"Looks like we agree with the speaker on his first two statements, then, Sam. And that brings us up to wages, and what he said would happen if they went up in a big jump."

"And that's where I don't understand him, Ed. I know *I* could buy lots more if *I* got twice as much money—that is, the Mrs. could. Why, if I took home double pay tomorrow she'd make a dash down to the Emporium in 10 flat."

"You bet she would, Sam. And a good idea, because if everybody else got double money, too, prices would go up so fast she wouldn't be able to run fast enough to keep up with them."

"What do you mean? Labor is only a small part of the cost of making anything."

"Oh, yeh? Think back on that one, Sam. For example, all we have to start with in making the machines we turn out at the plant is iron ore, you know. Now take all the factories, making all kinds of things.

"Why, if I took home double pay tomorrow she'd make a dash down to the Emporium in 10 flat"

Do you know that from 60 to 67 cents of every dollar taken in by factories goes to wages? And about another 18 cents to salaries? That's a total of around 80 cents. And believe me, if you doubled that, prices would have to go up."

"But wages could go up without being doubled, Ed. Suppose they went up only 25 per cent."

"Well, I happen to know, Sam, that at present prices that would take 84 cents out of every dollar industry gets. There wouldn't be enough left to pay salaries. There would be nothing for dividends and nothing could be saved to buy new machinery and to pay for things during bad times."

What, Never a Raise?

"Shouldn't we ever have a raise, then?"

"Sure we should. In fact, when things are going right, we're getting raises all the time. I mean that the things we buy are coming down in price. We buy more of them, and that's the same as getting a raise."

"But I like to feel it in my pocket, Ed. I want to *know* I'm getting it."

"And don't you, Sam? Don't you remember that you couldn't afford an automobile 15 years ago, because it would have cost you just about twice what it does now? And don't you remember you looked at the little old tires in the windows and wondered how you'd ever get $100 together for a set of four, if you did own a car? You remember you couldn't pay $140 or so for a washing machine for your wife? And do you remember that you didn't even know about radio, and that now you have two?"

"But if I had a raise—"

"*You* may get one, Sam—I don't know. I'm not saying everybody's getting all he ought to have. I'm only trying to show you that what that fellow said was right. You can't get blood out of a turnip, you know. And you can't hand around automobiles and washing machines and radios until they have been made. And you have to make 'em at low cost. And sell 'em at low prices—"

"Okay, Ed. I suppose that guy must have been right, since you agree with him. See you tomorrow."

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The series to date: 30-Hour Week; Townsend Plan; Labor Relations Law; Taxes; Mechanization; Employee Representation; Profits; Security; Wages. Each available in 3x5 pamphlet form for management to distribute to workers

Motor Starting Resistors

To insure smooth starting and acceleration they must be properly chosen for the duty and for the torque needed to start the load

R. F. EMERSON
Industrial Department, General Electric Company
Schenectady, N. Y.

MUCH trouble and expense would be saved if motors could always be depended upon to start and accelerate smoothly without the aid of starting resistors or other control devices. Controllers, switches, contactors, and relays are required not only to handle currents but also to make and break them. This means that they are sometimes subjected to rather severe service. Starting resistances or reactors must also carry high peak currents during acceleration periods; if for any reason the acceleration period is unduly prolonged, excessive heating and damage may occur.

The starting resistor for any motor should be proportioned to start the load properly. Sometimes the driven machine is connected to the motor by a belt or chain. Too violent application of starting torque may cause the belt to jump off; if a chain is used, the sudden taking up of slack may cause links to break unless the chain has been specifically designed to withstand such a starting method. It is a comparatively easy matter, however, to reduce the starting torque exerted by a motor by increasing the amount of starting resistance.

Sometimes a high-starting-torque load, for example a conveyor like that shown in Figure 1, having the torque characteristics indicated by curve *A* in Figure 2, will not always start with the control equipment furnished with the motor. In such instances the starting resistance may be altered to allow the motor to exert more torque at starting. If the motor is chain-connected or belted to the load, it may be desirable to have it exert a very light torque, just enough to take up slack, on the first point of the starter, but on the second point have the motor exert the maximum torque of which it is capable so as to assure that the load will start moving.

Curve *B* of Figure 2 represents the torque characteristics of another type of load, such as a centrifugal pump or fan, for which the torque at starting, represented by *OY* is much less than torque *OX* required to start the conveyor. With a centrifugal pump or fan the load increases very rapidly as the motor gains speed. However the torque load at starting is very light and a high starting torque on the part of the motor is unnecessary.

Classification of Resistors

Resistors for different classes of starting duty have been classified by N.E.M.A., as shown in the table.

These resistors have been tabulated in two ways—first, according to the per cent of full-load current on the first starting point and, second, according to the severity of the service. It will be noted that the first line in the tabulation is laid out for 25 per cent of full-load current. This is a very low torque point and might apply where a hoist motor has to take up loose cable before hoisting the load, to avoid whipping.

The last line is laid out for 200 per cent torque and higher, as would be found in a drive such as an outdoor conveyor where high static friction must be overcome.

In the first column the resistor is intended for 30 sec. duty out of every 15 min., which is very infrequent starting service. The last column is for very severe duty, since the resistor is required to carry the motor current continuously. Columns in between these extremes are for resistors used on duty cycles of greater or less severity.

For example, ordinary crane-hoist duty might take resistor No. 152, which provides for 50 per cent torque on the first point of the controller with the motor at standstill, and must be able to carry the motor current 15 sec. out of every 60. A crane hoist on more severe duty might require resistor No. 162 which still provides for 50 per cent torque at starting but is enough heavier to operate 15 sec. out of 45 seconds.

According to Ohm's law, the amount of direct current flowing in any circuit is equal to the voltage divided by the resistance. This law must be applied with care in a rotating d.c. motor, because it builds up a voltage that is counter to, or opposes, the applied line voltage and holds the current down to a low value just as a resistance would do. When the motor is at rest there is no counter-voltage available for holding the current down to a reasonable value; for this reason a starting resistance is inserted in series with the armature until the motor comes up to speed and can generate the normal counter-voltage.

Assume that a certain 50-hp., 525-r.p.m., 230-volt, shunt-wound d.c. motor has a full-load current of 185 amp. and an internal resistance of 0.11 ohms. Dividing 230 volts by 185 amp. gives 1.24 ohms. Subtracting 0.11 ohms from 1.24 gives 1.13 ohms, which is the amount of external resistance necessary to limit the current taken by the motor at rest to the amount taken when it is rotating at full speed and carrying

N.E.M.A. Classification of Standard Resistors

Apptox. Per Cent of Full-Load Current on First Point	*30 Sec. on Out of Each 15 Min.*	*5 Sec. on Out of Each 80 Sec.*	*10 Sec. on Out of Each 80 Sec.*	*15 Sec. on Out of Each 90 Sec.*
25	No. 101	No. 111	No. 131	No. 141
50	No. 102	No. 112	No. 132	No. 142
70	No. 103	No. 113	No. 133	No. 143
100	No. 104	No. 114	No. 134	No. 144
150	No. 105	No. 115	No. 135	No. 145
200 or over	No. 106	No. 116	No. 136	No. 146

Approx. Per Cent of Full-Load Current on First Point	*15 Sec. on Out of Each 60 Sec.*	*15 Sec. on Out of Each 45 Sec.*	*15 Sec. on Out of Each 30 Sec.*	*Continuous*
25	No. 151	No. 161	No. 171	No. 91
50	No. 152	No. 162	No. 172	No. 92
70	No. 153	No. 163	No. 173	No. 93
100	No. 154	No. 164	No. 174	No. 94
150	No. 155	No. 165	No. 175	No. 95
200 or over	No. 156	No. 166	No. 176	No. 96

full-load torque. With this amount of starting resistance the motor exerts a starting torque represented by *OZ* in Figure 2.

This amount of resistance is ample for starting the centrifugal pump (curve *B*). In fact, with more than 1.13 ohms of external resistance the motor could easily start this load. On the other hand, the conveyor represented by curve *A* has so much static friction that the 1.13 ohms of starting resistance must be reduced in order to allow the motor to take more current and thus exert enough torque to move the load.

For industrial drives the squirrel-cage induction motor is by far the most commonly used. When a starting resistor is calculated for this type of drive the internal reactance as well as the internal resistance of the motor must be considered.

It can be assumed that the reactance of a standard, general-purpose, squirrel-cage is about 2½ to 3 times the internal resistance. For a squirrel-cage motor equipped with a high-resistance rotor and used for driving hoists and elevators the resistance can be assumed to be equal to the reactance.

The combined effect of resistance, *R*, and reactance *X*, is called impedance, *Z*. This relationship can best be understood by referring to the triangle diagram in Figure 3. Consider the conditions that exist when starting a three-phase, 440-volt, general-purpose, squirrel-cage motor on full voltage. If the inrush current at starting is 125 amp. and the torque exerted at starting is 165 per cent of full-load torque, the motor impedance per phase can be calculated as follows:

$$Z = E \div (\sqrt{3} \times 1) = 440 \div (1.73 \times 125) = 2.03 \text{ ohms}$$

From Figure 3, $Z = \sqrt{X^2 + R^2}$

or $2.03 = \sqrt{X^2 + R^2}$

Since $X = 2\frac{1}{2} \times R$,

$$2.03 = \sqrt{(2\frac{1}{2}R)^2 + R^2} = \sqrt{5.06R^2 - R^2} = \sqrt{6.06R^2}$$

Solving for R,

$$6.06R^2 = (2.03)^2 = 4.12$$

$$R^2 = 4.12 \div 6.06 = 0.68$$

$$R = \sqrt{0.68} = 0.825 \text{ ohms}$$

Then, $X = 2.25 \times R = 2.25 \times 0.825 = 1.86$ ohms

Assume that it is desired to reduce this starting torque to one-fourth of 165 per cent of full-load torque by inserting resistance in series with the motor. The starting torque of a squirrel-cage induction motor varies as the square of the voltage impressed on each phase. Therefore, in order to reduce the starting torque to one-fourth of the torque obtained with full-voltage starting it is necessary to decrease this voltage by one-half. If this is done, the inrush current at starting will also be reduced by one-half, or to 62.5 amp. Using this figure, the new total impedance needed is found as follows:

$$Z_1 = 440 \div (1.73 \times 62.5) = 4.07 \text{ ohms}$$

Then the new total resistance needed becomes:

$$R_1 = \sqrt{(4.06)^2 - (1.86)^2} = \sqrt{13.02} = 3.61 \text{ ohms}$$

Since the internal motor resistance is 0.825 ohms, the external resistance becomes 3.61 — 0.825, or 2.785 ohms.

Therefore, if we insert a resistor of 2.785 ohms in series with each of the three motor leads, the starting torque becomes one-fourth of 165 per cent of full-load torque.

Of course, if the exact starting conditions are known before the drive is installed, a squirrel-cage induction motor can be purchased having a starting torque that will meet the requirements without the use of a starting resistor or compensator. The low-starting-torque type of drive, such as a centrifugal pump or fan, can be handled by a motor designed with high internal reactance for reducing the starting torque. Similarly, a high-starting-torque type of drive, such as a conveyor, compressor, or lineshaft, can be handled very successfully by a squirrel-cage motor designed to give high starting torque.

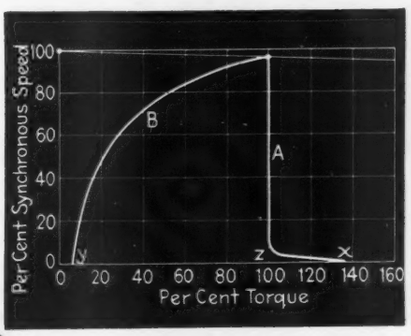

FIGURE 2. A high-starting-torque load (conveyor) is represented by curve *A*; *B* is the curve of a low-starting-torque load — a centrifugal pump or fan

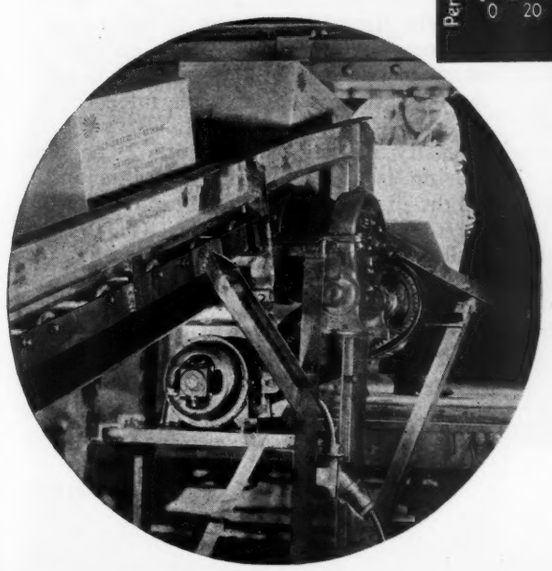

FIGURE 1. A conveyor of this type is an example of the high-starting-torque load indicated by curve *A* in Figure 2

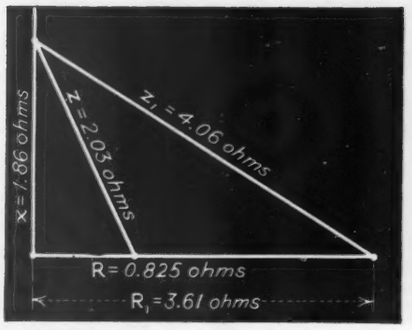

FIGURE 3. Impedance diagram for squirrel-cage induction motors

So-called rheostat data are usually available for wound-rotor induction motors. For example, a certain motor has rheostat data of 0.94 ohms good for 326 amp. This means that 0.94 ohms per phase, Y-connected in the secondary, will cause the motor to exert 100 per cent torque at zero speed. The current of 326 amp. which flows in the secondary is the full-load secondary current. If the motor is to exert 50 per cent of its full-load torque, as is often required for crane hoist service, twice 0.94 ohms or 1.88 ohms should be used. If more torque is required, the 0.94 ohms should be reduced.

For torque values up to, say, 125 or 150 per cent of full load, the torque can be considered as varying in inverse ratio with this external secondary resistance. Above 125 or 150 per cent of full-load torque, the amount of torque obtained at standstill becomes less than might be expected. It can usually be assumed, however, that about 20 per cent of the rheostat-data resistance will give the maximum torque the motor is capable of exerting at zero speed. Either more or less than approximately 20 per cent will give less than maximum starting torque.

When contemplating an increase of starting torque, consideration should be given to the effect of such a change on the electric power supply lines, as well as the effect on the load itself. There is a possibility that the increased starting current may cause lights to flicker, or in extreme cases the drop in voltage may cause undervoltage relays to stop other motors on the circuit.

Day Light, Night Light

Some 400 draftsmen in this room turn out their best work because the light is good. Mazda and high-intensity mercury-vapor units used in combination, assure light that ranges from 52 to 70 foot-candles

L. N. DAVIS
Plant Superintendent
Douglas Aircraft Company, Santa Monica, Calif.

SIZE of room and type of construction employed presented real difficulties in providing adequate illumination in our new engineering loft. Plant expansion and increased personnel necessitated new quarters for the engineering department. Because of the desirability of centralizing all the work in one room the site selected was a second-story loft in the original factory building 300 ft. long by 125 ft. wide consisting of 5 bays of the sawtooth type. The room accommodates 430 men and practically all the work consists of drafting.

Because of the exacting nature of the work, it was necessary to provide lighting intensities of from 52 to 70 candles on the drafting tables at all times. Normal daylight illumination is from skylights in the vertical planes of the sawtooth bays. Because of the layout of the factory it is necessary to curtain these skylights during the afternoon when direct sunlight produces uncomfortable glare. In addition, artificial light is necessary on dark days.

Necessary intensities were secured by means of two rows of 300-watt Mazda lamps in 500-watt Glassteel fixtures for each bay, together with one row of 1,000-watt high-intensity mercury-vapor units. The lamp spacing is 12½ by 8 ft. with a mounting height of 11 ft. for the Mazda units and 15 ft. for the mercury-vapor. The total installation consists of 48,000 watts of mercury-vapor units and 72,000 watts of Mazda, this combination having shown by experience to produce the right color values.

Draftsmen report that working conditions in this type of room are more satisfactory under the artificial illumination than with daylight.

If You Take Instrument Transformers for Granted

Remember that the safety of instruments, of the electrical system, and—more important still—of operators depends upon them

★

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Transformer Division
Westinghouse Electric & Manufacturing Company
East Pittsburgh, Pa.

TRANSFORMERS protect both instruments and operators from the high voltages of the system, and also make it possible to use standard low-voltage instruments on circuits of all voltages and capacities. Several factors determine whether these devices will give satisfactory service: (1) Insulation, (2) reliability, (3) accuracy, (4) application.

It is essential that the insulation of instrument transformers be able to withstand all conditions of service, including the high-voltage surges that are sometimes caused by switching or lightning. Insulation must therefore be of the best quality, impervious to moisture, and of ample strength to stand emergency stresses.

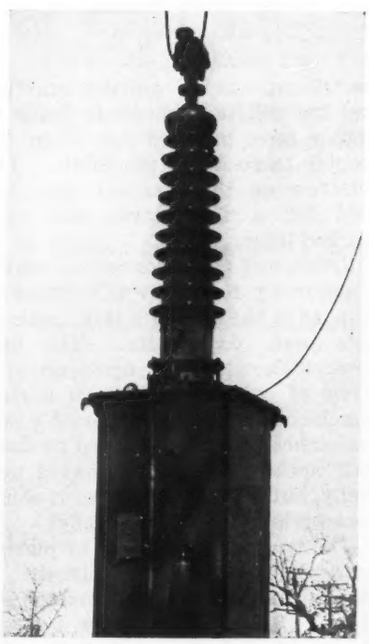
Instrument transformers must also be designed so that they will deliver voltages and currents that are accurately proportional to the voltages and currents in the power circuit, and reproduce very closely the phase relations in it.

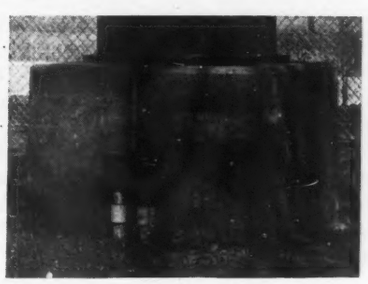
Current transformers are usually designed for 5 amp. on the secondary with rated primary current, although some applications may require other current values; therefore current transformers with special secondary characteristics are often built.

Voltage transformers are usually designed for a normal secondary voltage of 115 volts.

Instrument cases and the secondary windings of transformers should be grounded as an extra precaution against danger from high voltage in the event that the insulation between primary and secondary windings is punctured by lightning surges or other abnormal voltage stresses. With polyphase groups only one point of the secondary may be grounded but it is preferable to use a neutral point when available, or a common wire between two transformers. All grounds should be made either at the secondary terminals or as close to them as possible.

Many utility companies coordinate their entire system in certain levels. In such cases instrument transformers should be designed so as to be coordinated with the system, thus removing the possibility of their being the "weak link." This in no way decreases the efficiency of the transformer, but helps rather to maintain its high insulation strength.





They are not always hidden behind a switchboard. This current transformer is rated 132,000 volts

Reliability is the most important requirement of instrument transformers. In this connection the question is sometimes raised whether fuses should be used with potential transformers. It is not practicable to protect the transformer itself by means of a fuse, but fuses may be used to disconnect the transformer from the system in event of trouble, and thus prevent it from spreading to other parts of the system.

If fuses are used, however, it is customary to connect a resistor in series with them because of their limited interrupting capacity. The resistor should be sufficient to limit the current on a short circuit to 20 to 40 amp., a current that the fuses are able to break. The primary current in the transformer in normal operation is so small that the drop in the resistor is negligible.

One More Safety Measure

As an additional precaution, potential transformers are frequently installed in individual cells to isolate any trouble that may occur. A slightly greater cost of potential transformers and their installation is amply justified if it results in greater continuity of service.

Accuracy of instrument transformers is second in importance only to reliability, although not all applications demand the same degree of accuracy. If a transformer is to be used for experimental or research work, the highest accuracy is needed. When selecting an instrument transformer for such purposes it is advisable to order curves showing the

error under various load conditions.

For use with watt-hour meters, a high degree of accuracy is needed because even a small error is cumulative and may produce an appreciable difference in a month's bill. Some companies calibrate watt-hour meters with the transformers with which they are to be used.

When instrument transformers are used with indicating instruments or relays, a high degree of accuracy is unnecessary because standard instruments usually have from 1 to 2 per cent error at full-scale deflection.

Small switchboard designs of current and potential transformers are of dry-type construction. Current transformers are designed to carry loads of approximately 50 volt-amp. and are compensated to have the highest accuracy at 2½ volt-amp. Voltage transformers are usually rated at 200 volt-amp. and are compensated to give correct ratio at loads as low as 40 volt-amperes.

A Do and a Don't

Always short-circuit the secondary of a current transformer before disconnecting the burden . . . Never short-circuit the secondary of a potential transformer while the primary is energized

High-voltage current and potential transformers of the oil-filled type are designed to maintain their accuracy at all loads.

Special transformers can be compensated to give correct ratio at any specified secondary burden.

Voltage transformers are used with voltmeters, watt-hour meters, power factor meters, frequency meters, synchronoscopes and synchronizing apparatus, protective and regulating relays, and the low voltage and over-voltage trip coils of automatic circuit breakers. One voltage transformer may be used for a number of instruments if the total current does not exceed that for which the transformer is designed

(Continued on page 82)

Trouble Starts When Connections Fail

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THE National Electrical Code, inspection authorities, and much experience have taught how to make trustworthy connections. Coming into the business is a steady stream of young men who lack this basic experience. Teaching them how to make reliable, current-carrying connections is important.

There are still men, called electricians, who will heat a lug, fill it with paste and melted solder, ram the skinned end of a cold wire into it, and call it a job.

A Factory Was Shut Down

One morning such a lug, which carried the field current of a 500-kw. generator, decided that it had done enough work. The cable pulled out, the voltage died, and a large and busy factory was shut down. Cost of this one bad joint, about $1,000.

A 150-hp., three-phase motor in a textile plant burned out during starting. The plant was new and the motor manufacturer was responsible for motors and wiring.

The troubleman found one phase in the stator completely roasted out. Working back from the motor he pulled at the wires until he came to the auto-transformer starter. Here one joint felt too loose and limber. As the tape was removed the stranded cable came out of a sleeve connector of the setscrew type. This cable led to the two unburned phases, showing that it had been carrying no current while starting.

Then it came out that the mill electrician wanted quicker starting and had shifted the motor leads to higher taps, but had not taken the trouble to re-sweat the joints. The setscrew on the strained wire had held for a few starts, and then worked loose.

Sometimes a bad connection makes a motor try to run away, instead of stop, as in the case of a large, adjustable-speed, d.c. motor. The field control rheostat was made up of a circle of contact buttons on a slate panel, connected to the taps of a grid resistance. From low speed to about half speed the motor behaved normally, but beyond half speed it would race or hunt most erratically.

The trouble was located by placing an ammeter in the field circuit. It showed a fluctuating current at times. Shaking the wires between the panel and the grids disclosed a loose connection. Tightening this connection ended the trouble.

The rules say that joints must be made electrically and mechanically secure without solder, and must then be soldered unless made with a splicing device. Those directions are safe, and easy to follow.

Lugs bolted to terminals or to studs sometimes loosen, run hot, and melt off. Lock washers under all nuts and screw heads are good safety devices at such points.

Heavy strap copper connections, especially those in the series circuits of generators and motors, are subject to this trouble. Besides heating up they disturb operation by introducing resistance in the circuit.

Such connections should be tinned and wiped smooth while hot. Outside of the coppers, on both sides, there should be stiff, square washers of steel to spread the pressure and keep the copper from dishing. Nuts should have lock washers and the joints should be set up tight and examined once a year, oftener if the service is severe.

The ordinary lug in which the conductor is usually a loose fit is not particularly reliable for heavy duty, even when well soldered. A good workman will pack any excess space with pieces of copper wire to make the lug a driving fit on the wire before soldering.

Regular Maintenance Is Needed

The market now offers some excellent forms of clamping lugs that are really secure, both electrically and mechanically, without soldering and often are not sweated. If well set up and then soldered it is difficult to conceive a better terminal for heavy, stranded cable.

Regular maintenance inspection of equipment should include all bolted, clamped, or screwed joints in important circuits. This inspection might well include the plugs on flexible cords, where the stranded conductors ought to be soldered to the screws, but seldom are.

A.C. Wave Windings

Connecting diagrams and tables for windings having 5½ slots per pole per phase

A. C. ROE

WAVE windings having five slots per pole per phase were considered in the September issue. In this article windings with 5½ slots per pole per phase will be taken up, and the discussion on the method of winding armatures with odd and even coil couplings, using coils with short-pitch leads for more than two conductors per slot, will be continued.

The preceding article discussed the methods employed in arranging the coils into groups and marking the slots for windings using special short-lead coils and even groupings. Let us now consider a winding of similar nature, except for having odd groupings, such as the twelve-pole, four-conductors-per-slot, three-phase winding shown in the connecting diagram, Figure 8, and Connecting Table VIII.

This winding will have $3 \times 2 \times 12 = 72$ phase coils, or 36 right- and 36 left-hand phase coils. These coils should be divided into nine piles and three groups, as explained in the preceding article. The grouping will be as follows:

Group 1, 132 full-pitch coils
- (*a*) 24 Right-hand phase coils = (36 — 12)
- (*b*) 24 Left-hand phase coils = (36 — 12)
- (*c*) 84 Plain coils = (198—114)

Group 2, 42 short-pitch plain coils
- (*d*) 21 Top-lead, short-pitch coils = (4 + 3) × 3
- (*e*) 21 Bottom-lead, short-pitch coils = (4 + 3) × 3

Group 3, 24 short-pitch phase coils
- (*f*) 6 Top-lead, short-pitch, right-hand phase coils
- (*g*) 6 Top-lead, short-pitch, left-hand phase coils
- (*h*) 6 Bottom-lead, short-pitch, right-hand phase coils
- (*i*) 6 Bottom-lead, short-pitch, left-hand phase coils

The way to figure the number of coils in each of the nine groups (*a*) to (*i*) inclusive, for any winding using short-lead coils, with right- and left-hand phase coils, is as follows:

Total number of phase coils (*PC*), or (*a*) + (*b*) + (*f*) + (*g*) + (*h*) + (*i*), equals the number of poles times number of phases times 2. One half of the coils are right- and the other half are left-hand.

Then (*f*), (*g*), (*h*) and (*i*) always equal six coils each, or Group No. 3 takes 24 of the phase coils, of which twelve are right-hand and twelve left-hand.

Therefore in Group 1, (*a*) = *PC* — 12, and (*b*) = *PC* — 12. Then (*c*) (the number of full-pitch, plain coils) equals the total number of coils — [(*a*) + (*b*) + (*d*) + (*e*) + 24.]

In Group 2 both (*d*) and (*e*), (the number of top- and bottom-lead, short-pitch, plain coils) equal 3 times (the sum of the short-pitch connections under *SP1*, *SP3*, *SP5* and *SP2*, *SP4*, and *SP6* — 2), shown in the connecting tables.

The foregoing discussion indicates how to

Checking Chart VIII. 5½ Slots per Pole per Phase

No. Slots	No. of Poles	Polarity	Phases C							Phases B						Phases A					
		↑	12	11	10	9	8	7	...	6	5	4	3	2	1	Z	Y	X	W	V
		↓	..	28	27	26	25	24	23	22	21	20	19	18	...	17	16	15	14	13
66	4	↑	45	44	43	42	41	40	...	39	38	37	36	35	34	33	32	31	30	29
		↓	..	61	60	59	58	57	56	55	54	53	52	51	...	50	49	48	47	46
99	6	↑	78	77	76	75	74	73	...	72	71	70	69	68	67	66	65	64	63	62
		↓	..	94	93	92	91	90	89	88	87	86	85	84	...	83	82	81	80	79
132	8	↑	111	110	109	108	107	106	...	105	104	103	102	101	100	99	98	97	96	95
		↓	..	127	126	125	124	123	122	121	120	119	118	117	...	116	115	114	113	112
165	10	↑	144	143	142	141	140	139	...	138	137	136	135	134	133	132	131	130	129	128
		↓	..	160	159	158	157	156	155	154	153	152	151	150	...	149	148	147	146	145
198	12	↑	177	176	175	174	173	172	...	171	170	169	168	167	166	165	164	163	162	161
		↓	..	193	192	191	190	189	188	187	186	185	184	183	...	182	181	180	179	178
231	14	↑	210	209	208	207	206	205	...	204	203	202	201	200	199	198	197	196	195	194
		↓	..	226	225	224	223	222	221	220	219	218	217	216	...	215	214	213	212	211
264	16	↑	243	242	241	240	239	238	...	237	236	235	234	233	232	231	230	229	228	227
		↓	..	259	258	257	256	255	254	253	252	251	250	249	...	248	247	246	245	244
297	18	↑	276	275	274	273	272	271	...	270	269	268	267	266	265	264	263	262	261	260
		↓	..	292	291	290	289	288	287	286	285	284	283	282	...	281	280	279	278	277
330	20	↑	309	308	307	306	305	304	...	303	302	301	300	299	298	297	296	295	294	293
		↓	..	325	324	323	322	321	320	319	318	317	316	315	...	314	313	312	311	310
363	22	↑	342	341	340	339	338	337	...	336	335	334	333	332	331	330	329	328	327	326
		↓	..	358	357	356	355	354	353	352	351	350	349	348	...	347	346	345	344	343
396	24	↑	375	374	373	372	371	370	...	369	368	367	366	365	364	363	362	361	360	359
		↓	..	391	390	389	388	387	386	385	384	383	382	381	...	380	379	378	377	376

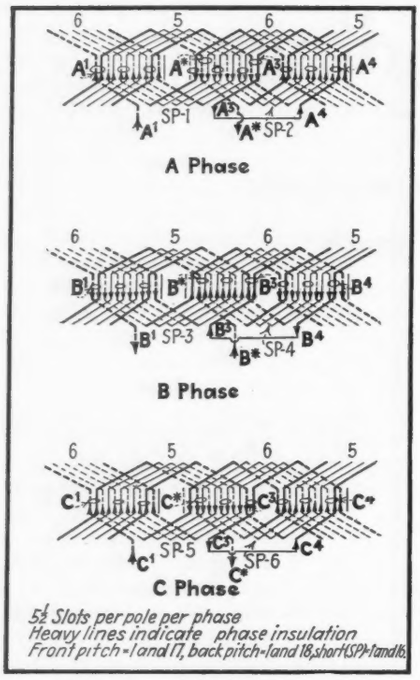


FIGURE 8. Connecting diagrams for a.c. wave windings having 5½ slots per pole per phase. These diagrams are to be used with Connecting Table VIII

arrange the coils into the proper grouping, with the correct number of coils in each group for any type of winding. The core should be marked as explained before. When the coil groupings are odd, as in the connecting diagram and Connecting Table VIII, care must be taken to preserve the proper grouping throughout the winding.

One method that can be used to keep an accurate check on the coil grouping is to mark the first and last coil of each group on the ends with white chalk. The first coil in would be marked on the top rear diamond point, as would the last coil of this group; likewise, mark the first and last coils of the next and each succeeding group. Therefore, there will always be two chalk-marked (phase) coils together, and the grouping can be checked at any point or at any stage of the winding process.

The preceding directions have referred primarily to new windings using new coils. When an old winding is to be stripped, the coils reinsulated and the rotor rewound with the reinsulated coils, the problem of marking the core and coils is somewhat different. In such cases the following suggestions will be helpful.

Check Windings Before Stripping

The first step, of course, is to determine the number of poles, phases, type of connection, number of slots, and number of slots per pole per phase. These data make it possible to select the proper connecting diagram, chart, and checking chart for the winding. Next, examine the winding carefully to determine whether special coils having short-pitch leads, and phase coils, are used. If phase coils are used, a check must be made to find out whether the phase coils are right- and left-hand.

Before stripping any winding a careful study of the lead arrangement at the six short-pitch locations should be made, the reason being that the short-pitch coils in the winding may have to be marked to insure their being replaced in the same location. This is true in a good many cases, although the original winding may not have had short-lead coils, for these reasons:

The new coils have leads longer than necessary, the excess length being trimmed off after all clips are in place. With the old coils there is only sufficient lead length to make the connection and if the short-pitch coils are mixed with the other coils, short leads are likely to result. The number of slots, diameter of rotor, and size of strap in the coils determine the possibility of ignoring this matter, but in most cases it is time well spent to segregate and mark these coils as follows:

Select the proper connecting diagram and table; pick any one lead, call it *A1*, and designate this section *SP1*. Then locate the other *SP* sections as *SP2*, *SP3*, *SP4*, *SP5*, *SP6*, and at each of these points mark both top and bottom leads. The simplest way is to mark all coils on the top leads only with a steel stencil. That is, start at the *A1* lead and stamp figure 1 on its top lead; then stamp each coil in succession consecutively, as 1, 2, 3, and so on. The numbers should run the same as in the checking charts; that is, from right to left, or counter-clockwise around the rotor.

Lay Coils Out in Sequence

With coils numbered in this manner the data given in the tables and charts can be used to insulate them properly. Before rewinding, the coils can be laid out in proper sequence, starting with the No. 1 coil on the bottom of the pile and ending with the last coil. Thus when winding the highest-numbered coil, the one to the right of coil No. 1 or *A1*, is put in first and the numbers run backward, ending with coil No. 1.

With this method the coils must be sorted into piles for insulating, as outlined in the foregoing discussion.

The next article, to be published in an early issue, will present the diagrams and tables for windings having six slots per pole per phase and discuss the methods of insulating them.

Connecting Table VIII.* 5½ Slots per Pole per Phase

No. of Poles	No. of Slots	A Phase Bottom Leads A^1	A^*	A Phase Top Leads A^3	A^4	B Phase Bottom Leads B^1	B^*	B Phase Top Leads B^3	B^4	C Phase Bottom Leads C^1	C^*	C Phase Top Leads C^3	C^4	Short Pitch Connections SP 1-3-5	SP 2-4-6
4	66	↑ 1	50	46	30	↓ 23	6	2	52	↑ 45	28	24	8	5	4
6	99	↑ 1	83	79	63	↓ 23	6	2	185	↑ 78	61	57	41	5	4
8	132	↑ 1	133	129	113	↓ 56	39	35	19	↑ 111	94	90	74	5	4
10	165	↑ 1	149	145	129	↓ 56	39	35	19	↑ 111	94	90	74	5	4
12	198	↑ 1	182	178	162	↓ 56	39	35	19	↑ 144	127	123	107	5	4
14	231	↑ 1	215	211	195	↓ 155	138	134	118	↑ 78	61	57	41	5	4
16	264	↑ 1	248	244	228	↓ 89	72	68	52	↑ 177	160	156	140	5	4
18	297	↑ 1	281	277	261	↓ 155	138	134	118	↑ 111	94	90	74	5	4
20	330	↑ 1	314	310	294	↓ 221	204	200	184	↑ 111	94	90	74	5	4
22	363	↑ 1	347	343	327	↓ 122	105	101	85	↑ 243	226	222	206	5	4
24	396	↑ 1	380	376	360	↓ 155	138	134	118	↑ 276	259	255	239	5	4

* See Figure 8 for connecting layout. Front pitch = 1 and 17; back pitch = 1 and 18. Short pitch (*SP*) = 1 and 16.

Motor and Controller Maintenance

ALL MOTORS and control equipment are numbered before putting into service, then listed on proper cards. These cards must check and agree with the accounting department's records. All such records are maintained in the plant engineer's office for ready reference.

Motor Record—All motors except those that are an integral part of the equipment (such as adding machines and other office equipment) are numbered with brass tags. Motor numbers start with 1 and continue serially.

Motor record cards (Figure 1) are filed by number. Duplicate motor record cards, which bear only the motor number, are filed by burden centers.

The record card is completely filled out and all pertinent data are added from time to time covering repairs, tests, transfers of location, or removal. The duplicate card is likewise refiled under the correct burden center.

Motor Controllers and Line Switches—All motor controllers and starters are numbered by painting or stenciling. Numbers start with 1 prefixed by a "C" and continue serially.

Switches are small items compared with motors or controllers, but to facilitate proper maintenance and better control they are also marked by painting or stenciling. Numbers start with 1 prefixed by "S" and continue serially.

A record of all controllers and switches (Figure 2) is kept.

Removal or Transfer of Equipment—When a motor, controller, or switch is transferred, removed to idle storage, sold, or junked, a notice of equipment removal (Figure 3) is filled out and forwarded to the accounting department. The same information is entered on the record card or sheet.

When the equipment is a motor, the duplicate motor record card is refiled under the proper burden center.

When equipment is removed from the plant account by being sold or junked, the record is so marked, but the card or sheet is destroyed. The numbered continuity of the record cards is maintained to prevent possible mistakes.

Inspection and Testing of Motors and Controllers—All motors, controllers, and switches are inspected and tested at regular intervals.

Responsibility for Inspections—The electrical crew is entirely responsible for making all inspections and tests of motors, controllers, and switches. The inspector notes his findings and recommendations on the motor inspection check sheets (Figure 4) and submits them to the plant engineer for review.

Intervals of Inspections—Inspections are made at regular intervals, as noted on the master inspection schedule (Figure 5). Frequency of the inspection of the various kinds of equipment is determined by the plant engineer.

The mechanical department dispatch clerk determines each day from the master inspection schedule the equipment to be checked the following day. He prepares for the inspector a sufficient number of motor inspection check sheets for the day's work.

Reporting the Inspector's Findings—The motor inspection check sheets are given to the plant engineer the day following the inspection. He reviews each sheet and makes note of any and all findings that require attention, and informs the proper individuals of the recommendations made with regard to the equipment.

Accounting for Inspection Time Labor—The electrical inspector notes his time and charges each burden center accordingly. It is not necessary to secure a repair request (Figure 6) for inspection labor, but if any repairs are made, regardless of how minor, except as later noted, it *is* necessary to secure a repair request for the work.

Inspection of Motors—All motors are given a complete checking semi-annually; some require it more often. This inspection includes an insulation

MOTOR CONTROLLER & LINE SWITCH RECORD FIGURE 2

Controllers							Switches					
No.	H.P.	Volt	Amp.	Type	Mfg.	Cat. No.	No.	Volt	Amp.	Type	Mfg.	Cat. No.

MOTOR RECORD

D.C. Motor No.

Hp.___ Volt___ Amp.___ Full Load R.P.M.___
Type___ Form___ Wound___ Model___ Mfg.___
Serial No.___ Bearings P.E.___ C.E.___
Frame___ No. Poles___ No. Com. Poles___ Temp. Rise___
Arm. Coil___ Sh. Field___ Series Field___ Com. Field___
No. Brushes___ Brush No.___ Shaft Dia.___ Keyway___
Spec. No.___

Note: Enter numbers of motors which are duplicates and which may be used as spares

Operating Data					Control Equip. No.	
Date	Location	Driving	Mach. R.P.M.	Pulley or Gears	Starter	Switch

FIGURE 1

NOTICE OF EQUIPMENT REMOVAL

No.___
Asset No.___ Date___ By___
Name of Equipment___
Mfr's Name___

Moved From___ B.C. No.___ Bldg. No.___ Floor___
Moved To___ B.C. No.___ Bldg. No.___ Floor___
Operating speed of Machine___
If a Motor: State what machine it drives___ Asset No.___
Remarks:___

FIGURE 3

Prepared by FREDERIC OAKHILL, Plant Engineer, Bauer & Black, Chicago

MASTER INSPECTION SCHEDULE

Date: Period____ Week____ Day____

The following motors are to be inspected on the above listed day

Motor No.	Burden Ctr.	Motor No.	Burden Ctr.	Motor No.	Burden Ctr.

FIGURE 5

PRODUCTION MACHINERY OPERATION SPEEDS

To: METHODS DEPT. By____ Date____

The following machines were checked today for their operating speeds. Please compare with your records and if any discrepancies exsist notify the Plant Engineer so that standard speeds can be re-established.

Asset No.	Production Machine	Speed	Motor No.	Remarks

FIGURE 7

MOTOR INSPECTION CHECK SHEET D.C.

Motor No.____

Date____

Dept.____ Driven Machine____

Location____ Machine Speed____ R.P.M.

Surrounding Conditions____

Bearings____

Oil____

Brushes____

Commutator____

Megohm Meter Readings____

Full Load Amps.____

Starter or Contr

Condition of Con

Condition of Dri

Remarks:

Air Gap Readings

FIGURE 4

FIGURE 6

Request No.	Received / Completed	Job Order No.

REPAIR OR EQUIPMENT REQUEST

Date	Hour A.M. / P.M.

Nature of Request

Signed____ Foreman

Machine Available / When Wanted	Elect. / Steam / Mach.	Carpenter / Painter / Labor / Outside

I Have Completed Repair Stated Above	Repair Inspected and Equip. Found Operative
Repair Man	Foreman

Not Finished Unless Clean and Safe

Remove Tools, Etc. — Replace Guards

and load test. At more frequent intervals all motors are checked for the ordinary faults due to continued usage.

Inspection of Controllers and Line Switches—Inspection consists of going over each part to see that it functions as it should. Each installation is analyzed from the standpoint of reliability, adequacy, and suitability for the job it is supposed to be doing.

Recommendations for Replacements—When experience shows that the equipment is undersized, of obsolete design, or that the cost of maintenance is excessive, consideration is given to replacing it.

Driven Machine Speed—The operating speed of the driven machine is determined and reported to the methods department on a production machinery operating speeds form (see Figure 7).

Deferring of Inspector's Recommendations—The inspector reports his findings to the plant engineer. It is not the inspector's responsibility to see that his recommendations are carried out, but it is his responsibility to report the same fault repeatedly if it has not been remedied between inspections.

The responsibility for autherizing work lies with the department head and the management.

Maintenance of Motors and Controllers—Inspections should disclose impending trouble and follow-up maintenance should prevent excessive repair costs.

Oiling of Motors—All motors are oiled at such intervals as experience indicates, and the schedule for this work is rigidly observed.

Oil wells are drained and cleaned at intervals sufficiently frequent to prevent large accumulations of dirt and lint. Anti-friction bearings are given particular attention to see that the lubricant does not harden or oxidize, and prevent free running of the unit. The oiler notes his time and charges each burden center accordingly. It is not necessary to secure a repair request for oiling time labor.

Cleaning Motors and Controllers—All motors and controllers are cleaned at such intervals as experience indicates, and this schedule is rigidly observed.

All dust and lint are blown out, the commutator is cleaned, and the brushes are adjusted. It is advisable to do the oiling and cleaning of the motors at the same time.

The electrician notes his time and charges each burden center accordingly. It is not necessary to secure a repair request for this work.

Maintenance of Equipment—The maintenance of equipment other than oiling and scheduled cleaning must be authorized by a properly signed repair request.

It is required that all repairs be of first-class workmanship, and that they be done as economically as possible.

Special care is given to motors that are subjected to alternate freezing and thawing, moisture, corrosive fumes, or severe dust conditions.

Storage of Idle Equipment—Idle motors and controller equipment are stored in the mechanical storeroom.

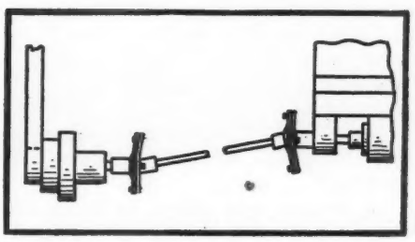
Care is exercised to see that the equipment is kept dry and clean and free from dust.

Operating Shorts

New Universal Joints Solved Lubrication Problem

PHILIP F. ATWOOD, *Terryville, Conn.*

A retooling program involved speeding up some milling machines equipped with power traverse tables. These tables were driven by a shaft with two all-metal universal joints separated by a splined shaft, to allow for shortening.



At the new high speeds, these joints immediately began to fail, because of the difficulty of lubricating them properly. Use of boots to retain the lubricant was suggested, but before putting them on it was decided to try leather-disk universal joints with metal yokes. These joints eliminated the need of lubrication, as well as the splined shafts, because the leather disks are able to take care of the small change in shaft length when the table is raised or lowered.

They have now been in use for several years and have given no trouble.

Mr. Atwood's contribution has been awarded the $10 payment offered by the editors for the best Operating Short submitted during the past month.

Phase Rotation Indicator for Checking Receptacles

THOMAS R. TURNER, *Buffalo, N. Y.*

Various portable machines in our plant receive power from three-phase, 440-volt, receptacles of which we have a considerable number. In order to have the machines run in the proper direction, it is necessary that the phase rotation be the same in all outlets.

During a recent modernization program additional receptacles and plugs of a later type were installed. Dragging a motor or machine around to check the phase rotation would have entailed so much time and labor that it was decided to make an indicator from some odds and ends that were lying around the shop.

Referring to the diagram, *A* is a 440-volt coil complete with core and polepiece, from an old magnetic switch. It would have been inconvenient to use eight lamps; so two small, no-voltage coils, *B*, were taken off the laminations and each was placed in series with a 25-watt, 120-volt lamp in the two outside legs of the circuit. Coils and lamps were then mounted in a 7x7x7-in. box and wired to a plug.

When the plug is inserted in a receptacle one lamp burns at full brilliance, whereas the other is dim. Changing any two line wires in the receptacle will make the dim lamp bright, and the bright one dim. The box was marked for the desired rotation.

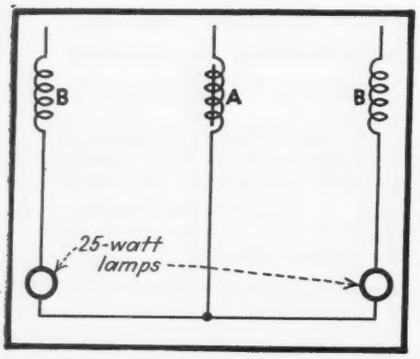
This device also serves as a check

Safety Shutoff Buttons for Conveyor Line

SOURCE, *Caterpillar Tractor Company Peoria, Ill.*

Along the diesel engine assembly line safety shutoff buttons have been placed every few feet. These buttons are attached to the upper corner edge of the conveyor housing, and they are shutoff buttons only. They safeguard the work, workers, and conveyor.

To restart the conveyor chain, it is necessary for someone to go to the control box and throw the switch. There have been a few instances of shutoffs which were not warranted and which could not be traced to the particular individual who pressed the shutoff button. If the individual could restart the conveyor, this sort of thing might be more prevalent.



for open circuits in the receptacles. An open in the middle leg will cause both lamps to glow dimly. An open in either of the outside lines will prevent the lamp in that line from glowing.

Installation of phototube control on machines cutting and folding woven labels has stepped up production 10 per cent on each machine.

Saves Power and Labor in Handling Turnings

X. R. DODGE, *Vice-President*
Automatic Screw Machine Products Company, Chicago

Handling of turnings from our automatic screw machines has been simplified by changing the type of container. Usually the turnings and parts are raked from the machine pan into a rectangular, sheet-steel box and taken to a centrifugal separator for extracting the oil, before winnowing or separating the parts from the turnings.

Instead of using the rectangular box we rake the turnings into one of the conical steel buckets used in the centrifugal separators, thus saving a rehandling. The buckets cost more but last longer, so that the ultimate cost is about the same.

Since the rectangular boxes hold about one and one-half buckets of turnings the separator was formerly operated with one bucket only partially filled. This practice resulted in a waste of power.

Buckets are handled to the centrifugal separators, and from them to the winnowing machine by an electric hoist running on a monorail. The winnowing machine discharges the turnings directly into storage.

The rectangular boxes are still used for long turnings which must always go to the shavings breaker before separation.

Watch Your Step When Climbing Ladders

SOURCE, *A. O. Smith Corporation Milwaukee*

One of the major causes of ladder accidents is loss of balance or slipping by the person using the ladder. Prevention of this kind of accident depends on knowing how to use ladders correctly.

Some of the important things to remember when using ladders are:

1. Select a ladder which is in good condition—not broken, warped, or weakened. Beware of the ladder that has been standing in the weather, especially when it is water-soaked.
2. Use ladders with safety shoes in preference to those without, but be sure that the shoes are the kind that will prevent slipping on the surface the ladder stands on.
3. Tie a ladder at the base to keep it from slipping on extra-slippery surfaces, or have someone hold it firmly in place.
4. If you are going to have repeated use for a ladder in one place, lash it in position.
5. When you use a stepladder make sure that it is fully spread before climbing on it.
6. Never place a ladder in front of a door without first locking the door, or placing someone on guard.
7. If your shoes are greasy, muddy, or otherwise slippery, clean them before you climb.
8. Be sure that the ladder is placed at a safe angle.
9. Never let anyone climb a ladder with you. One man is enough of a load for all ordinary ladders.
10. Keep both hands free for climbing, whenever possible.
11. Always face the ladder while climbing either up or down.
12. Keep your eyes on the rungs when you climb. There might be a broken or a weak rung which slipped by the inspection.
13. Never lean far to one side of any ladder. Take time to move it.

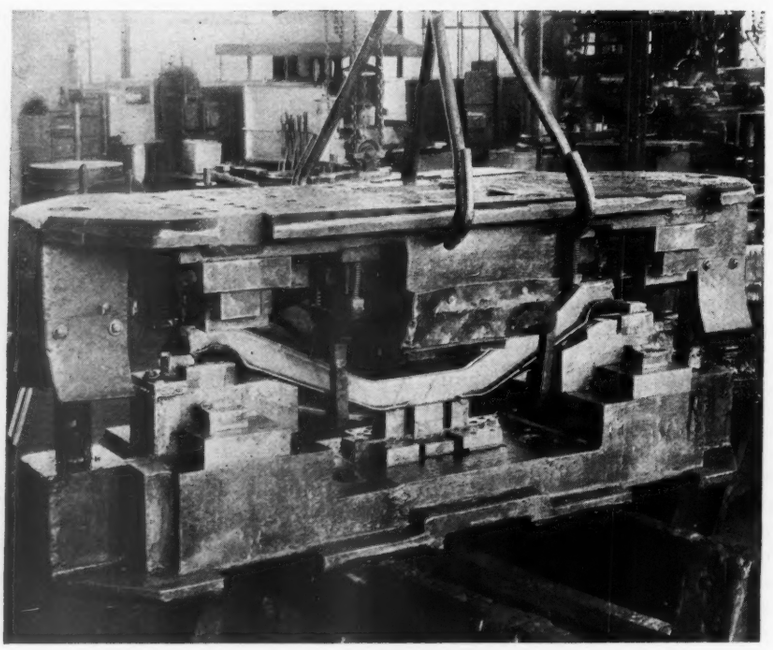
Guarding Hands on Stamping Presses

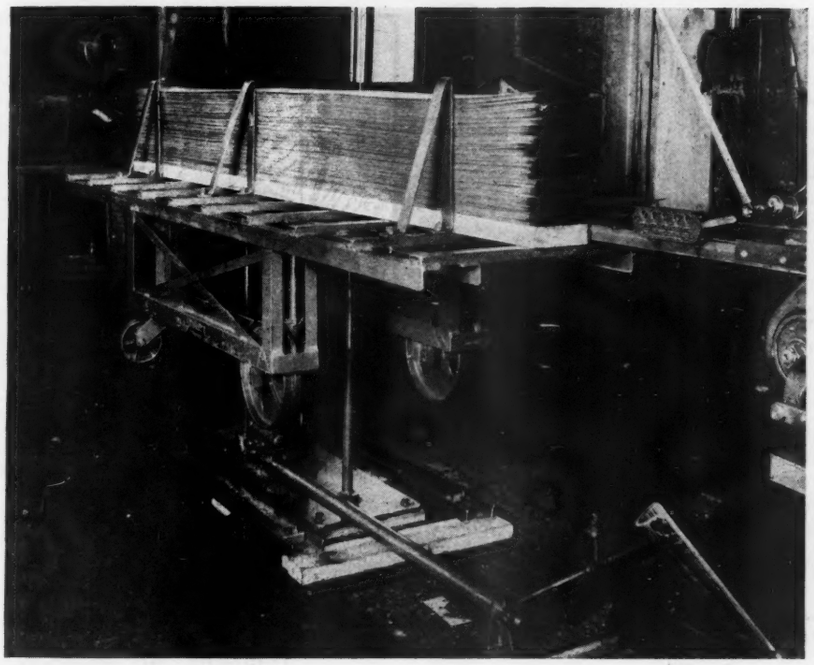
R. A. SHAW, *Safety Engineer*
The Murray Corporation of America Detroit

On stamping presses, automatic ejection of the stamping eliminates a hazard to the operator's hands. On this press, two vertical arms, spring-actuated, move downward with the press. Grooves in the base deflect the arms under the part and the two springs force the arms into a vertical position once more. As the die starts up, the right-angle face remains under the part, loosens it from the die, lets it fall out at the rear of the press.

Leather flaps on the end posts are there to warn operators in the event that they have thoughtlessly placed their fingers where they may be crushed.

Handling slots in the die are rounded so that lifting ropes and cables won't fray and break, causing injury as the casting falls.





Speeds Handling of Sheet Steel

FRANCIS A. WESTBROOK
Center Conway, N. H.

Steel that is to be slit, in the plant of the Emerson Electric Company, St. Louis, is loaded on a specially constructed truck which is pushed over a hydraulic lifting device operated by a foot pedal. This lifter is located close to the slitting machine.

In the lowered position the top of the pile of sheets is at the proper height for sliding them directly into the machine; as the pile becomes lower the operator presses his foot on the pedal, thus raising the load and keeping it at the desired level until the pile is used up.

•

Simple Method of Tightening Loose Armature Spider

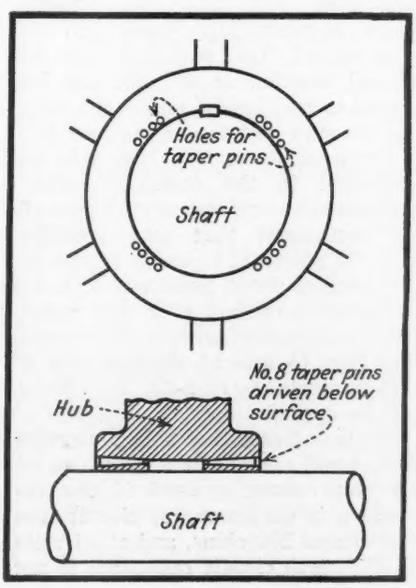
J. DIXON, *Ampere, N. J.*

After many years of service the hub of a 400-kw. generator armature worked loose on the shaft. This condition caused an objectionable knock, and an ingenious method was used to remedy it.

Sixteen holes, located so that a wall of iron about 3/16 in. thick was left between hole and shaft, with a similar wall between holes, were drilled in the hub and reamed for No. 8 taper pins. As will be seen from the sketch the holes were spotted in groups of four, the groups being spaced 90 deg. apart around the shaft.

After drilling and reaming the holes the shaft was turned so that one group of holes was at the bottom; then four pins were driven tightly into these holes. The shaft was again rolled to bring the opposite group of holes to the bottom, and pins were driven into them. The two remaining groups of holes were likewise fitted with pins, while in the downward position.

All the pins were cut off flush with the face of the hub; then by means of a drift and heavy hammer they were driven somewhat below the surface of the hub. After this the edges of the holes were peened over to avoid any possibility of the pins working out.



When the job was done, it was found possible to insert feeler gages between the shaft and the hub at points between the groups of holes, showing that the looseness had been serious.

When the generator was again placed on the line the knock had disappeared. After several years of service the unit is still in satisfactory condition.

•

Air Conditioning to Keep Dirt and Noise out of Building

SOURCE, *Sloss Sheffield Steel & Iron Company, Birmingham, Ala.*

Air conditioning of our four-story office building was prompted by the smoke, dust, fumes, and noise with which the atmosphere about our plant is contaminated. The building is adjacent to one of the company's operations, and an iron furnace with its numerous smokestacks is located on one side, a spray pond on another, a concrete mixing plant on another, and railroad tracks on the fourth. In addition, one of the city's main traffic arteries passes in front and there is constant automobile and street car traffic.

The building has 38 rooms and 8,500 sq. ft. of space. A 25-ton installation was made. Each floor has two main supply ducts with automatic zone control. By the use of dampers each side of the building is kept at the same temperature regardless of which side is getting the direct rays of the sun. A rock wool insulation was used for the roof and walls.

Steam coils were provided to temper the outside air and bring it up to room temperature in winter time. The installation is designed to provide an 80-degree temperature in the summer and 70 degrees in winter, with a relative humidity of 47 per cent the year round.

Two 10-hp. motors provide the power necessary for the operation of the condensers while one 3-hp. motor drives the fans. Since no room for housing the equipment was available in the building, a small building was constructed alongside the office building.

Now our office workers can work in a dust- and fume-free atmosphere with the awful din shut out. The temperature in which they work in summer is more comfortable too.

SPECIAL NOTICE

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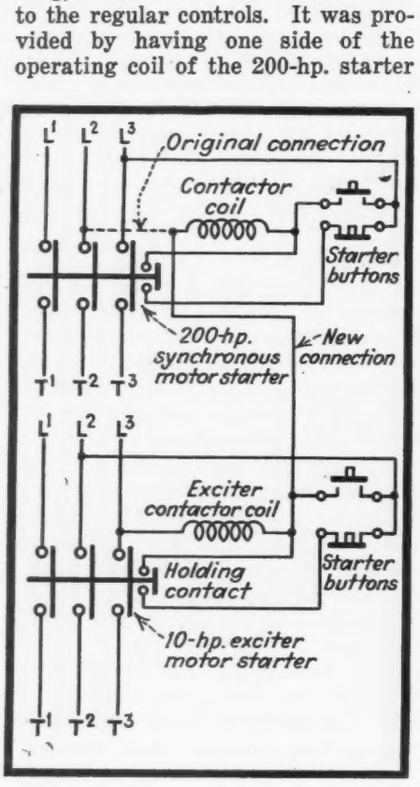
$10 will be paid for the best Operating Short submitted during the month of November. The Editors are the judges. Other Shorts accepted will be paid for at attractive rates

Control Interlock Protects Synchronous Motor

J. G. CRAFT, *Electrician*
Caribou Mining & Smelting Company
Caribou Gold Mines, Nova Scotia

One of our air compressors is driven by a 200-hp. synchronous motor. The exciter is a separate m.g. set, whose generator is driven by a 10-hp. motor. Both motors are controlled by across-the-line push-button starters.

In order to prevent the possibility of a new operator starting the large motor when the exciter is not running, an interlock circuit was added to the regular controls. It was provided by having one side of the operating coil of the 200-hp. starter energized through the holding contact on the exciter starter contactor, instead of by direct connection to the line.



In addition to insuring the proper sequence of starting the two units, the interlock also provides another point at which the synchronous motor may be stopped.

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Ground Protection for Portable Equipment

C. O. VON DANNENBERG
Jamshedpur, India

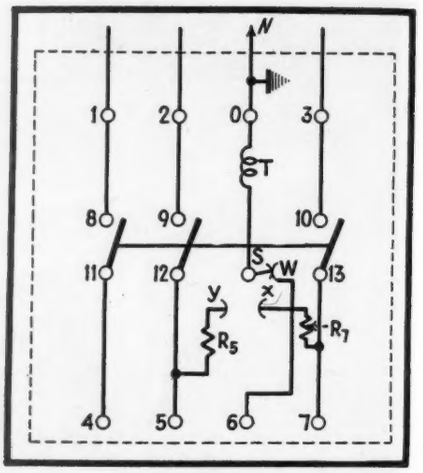
Protecting barefooted native workmen from electric shocks is an important matter at a steel company in India. They react unfavorably to shocks, and fatalities on 230-volt circuits are not at all uncommon.

It is necessary, therefore, for all portable appliances to be provided with a grounding conductor which is connected to all normally non-current-carrying metallic parts, such as frames, sheaths, and the like. This conductor is grounded at the supply point and when the ground resistance exceeds 1 ohm an automatic device known as an earth leakage trip is provided so that when a ground fault occurs at any point between the supply and the appliance itself, the circuit is automatically opened. Details of the device are shown in the sketch.

Current enters at terminals *1*, *2*, and *3*, and *O* if a three-phase, four-wire circuit is used. Terminal *O* is connected to an auxiliary ground. The fourth wire of a fourth-wire circuit is carried around the switch. The circuits continue through contacts *8-11*, *9-12*, and *10-13*, which opens automatically when coil *T* is energized. Test switch *S* is in its normal position at *W*, but can be turned to positions *X* and *Y* for testing through resistances *R5* and *R7*.

Terminal *6* on the load side is connected to the frame or other metallic non-current-carrying part of the equipment that may possibly have its potential to earth raised. If a conductor from terminals *4*, *5*, or *7* comes in contact with any metal part connected to terminal *6*, current will flow to ground through coil *T* and contacts *8-11*, *9-12*, and *10-13* will be opened.

Tests indicate that this protective device will operate at a minimum of 24 volts above ground if the resistance in the grounding circuit does not exceed 200 ohms, and at 65 volts if the earth circuit resistance is not more than 800 ohms. It is trip free, and cannot be held closed when a ground exists on the load side.



Difficulty in accounting for returned beer cases led two breweries to install electric counters on conveyors, which automatically register their tallies in the plant superintendent's office.

For Heat Protection, Asbestos and Waterglass

JOHN E. HYLER, *Peoria, Ill.*

Silicate of soda, or waterglass as it is sometimes called, can frequently be used to advantage in maintenance work. One important use is in the lamination of asbestos paper when for any reason it is necessary to use extra-heavy material.

Waterglass itself has heat-resisting qualities; therefore it is well adapted to serve as a natural teammate to asbestos. When such paper is laminated with waterglass it will not tear so readily. Among other applications it can be used for holding pieces in a vise when they are to be soldered or heated, and is effective in preventing the conduction of heat away from the parts.

Another interesting combination of asbestos and waterglass is a kind of paint. To prepare it, mix three parts of water with one of waterglass and into it stir very finely ground asbestos paper until the mixture is of the thickest consistency that can be handled properly with a fairly stiff brush. As many coats may be applied as desired, provided sufficient drying time is allowed between coatings.

Questions & Answers

CONDUCTED BY

G. A. Van Brunt

Controlling Waste of Raw Materials

What can be done by a small company to control the waste of raw materials? We employ about 30 men, making novelty furniture and wood specialties. The wood, mostly gum, is cut to dimensions by the sawyer and then put through a number of operations before it is glued and finished. Would it be advisable to put in a regular storeroom system and storekeeper? We are undoubtedly losing more than we should through spoiled material, also by the accumulation of obsolete items.

YOU HAVE two problems: Controlling spoilage, and avoiding the accumulation of unsalable items. It is doubtful, however, whether it would be advisable or necessary to develop a very elaborate stores system to handle either problem.

To control spoilage, work up standard bills of material for each article put into process. These bills of material, showing the number of board feet to be allowed for each item, including waste, should be made up at the time you put the piece into production. Against these standard allowances check the actual yield in making up a lot.

To make this check have the sawyer make out a report of the number of board feet of a given grade of gum, or other lumber stock, cut up for each order. In a small plant such as yours it should not be difficult for the sawyer to make such a report.

Having a record of the amount of lumber and other important raw materials used, you could then check this at weekly or monthly intervals against the totals completed on each lot. In order to make this accounting effective as a control two conditions will have to be met. First, there should be specific orders for all work done by the shop, and these orders should be closed out on completion, the number of good pieces shipped being noted by the foreman. Second, the sawyer should keep a separate record of, and report to the office or bookkeeper, any replacement or additional lots of material, beyond those specified in the original bill of material for an order.

Another method of determining whether the spoilage is serious enough to demand attention would be to weigh, or estimate the weight of, lumber issued to the shop during a week, and then weigh the scrap for the week, as it is sent to the boiler room or otherwise disposed of. Inspection of the rejected pieces will be helpful in determining whether the loss is due to defects in the wood or to poor workmanship and, if the latter, at what points in the shop it is occurring.

With regard to the accumulation and disposal of out-of-style and obsolete merchandise, it would be advisable to make a clearance of such items at the close of every season, selling them for what they will bring. They do not increase in value as fast as they gather dust.

The main problem, of course, is to avoid making up such stock in the first place, although it is probably impossible to guess correctly every time, and some chances have to be taken in putting out new items, if any successes are to be scored.

In recent years there has been a very distinct trend towards more systematic and cautious control of style items. In the first place, manufacturers usually make a careful canvass of the probable reception of new numbers, before going much beyond the sample stage. Furniture exhibitions, showings of household goods, toys, and many other lines, give a good indication of the reception of new numbers and the interest still being shown in the more staple lines. If

(Continued on page 86)

ANSWERS WANTED

Painting Newly Plastered Walls

As the result of changes in our buildings we have several new walls, some of which have an ordinary white plaster coating, while others have a cement finish. The work was done about a month ago. We want to finish some of these walls with a light-colored, interior wall paint, but are wondering whether there is any danger of the new plaster and cement discoloring or burning it. How long should new walls be allowed to dry out before it is safe to paint them? Is it necessary to give them any preliminary treatment? —H.J.E.

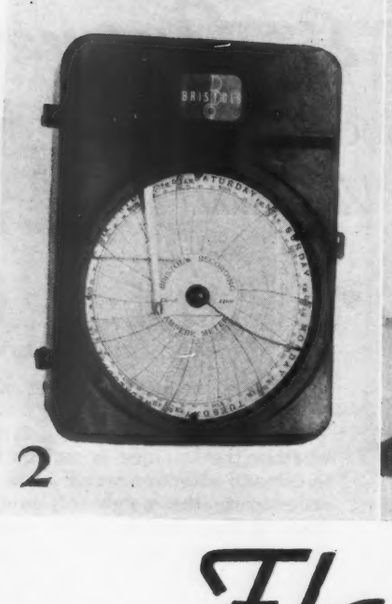
Trouble from Belt Slippage

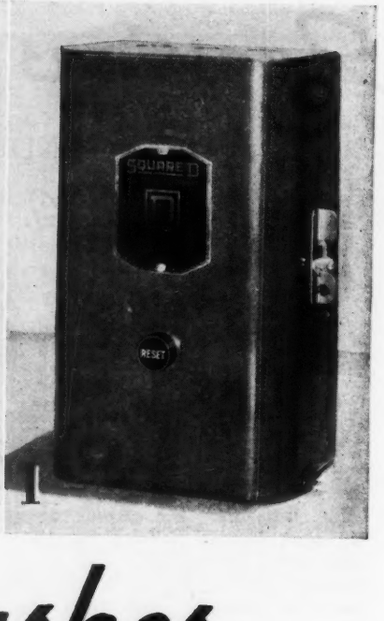
A rubber belt is used to drive a fan from a 40-hp. motor which has a crowned, cast-iron pulley. The belt is kept as tight as practicable, but at times it causes considerable trouble by slipping. I should like to know: (1) Whether there is any good way of removing the smooth, glazed surface that develops on the inner side of the belt. (2) Would it be advisable to replace this motor pulley with one that has a rougher surface? Or would it be feasible to cover the face of the present pulley with leather or canvas to give it a better gripping surface? How should such a covering be attached to the pulley? —F.P.H.

How Locate Grounds in Distribution System?

We distribute power over a three-phase, 60-cycle, 220-volt system. Recently a temporary disconnecting switch was put in one of the feeders while changes were being made. With this switch open so that no current was flowing, although the lines were hot up to the switch, a spark was noticed when one of the lugs connecting another switch farther back on the line was disconnected. No spark was obtained when the other two lugs were disconnected. Using a voltmeter I found that a voltage exists between two lines and a junction box, but none between the third wire and the box. So far no trouble has been experienced with any of our equipment.

What is the quickest way of locating such grounds? Is it necessary to use an insulation resistance meter, or will some other kind of testing equipment be satisfactory? —M.W.B.





Flashes

from the equipment makers

1 Automatic starter. Square D Co., Milwaukee

2 Ammeter. The Bristol Co., Waterbury, Conn.

3 F-3105 Goggle. American Optical Co., Southbridge, Mass.

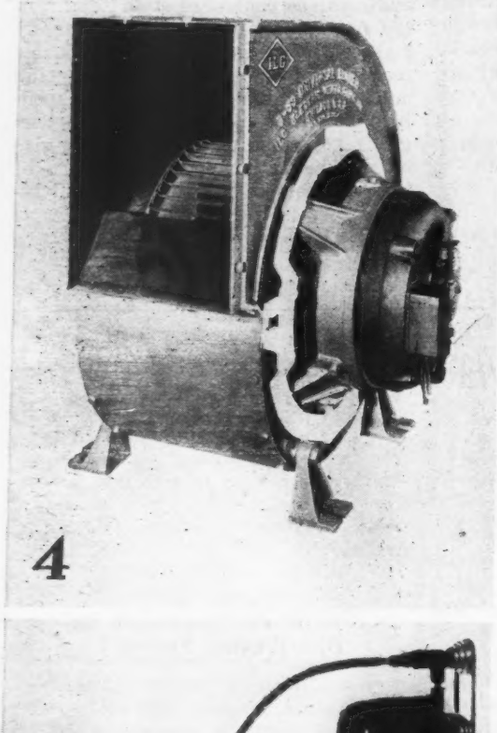
4 Floated-drive bracket for blowers. Ilg Electric Ventilating Co., Chicago

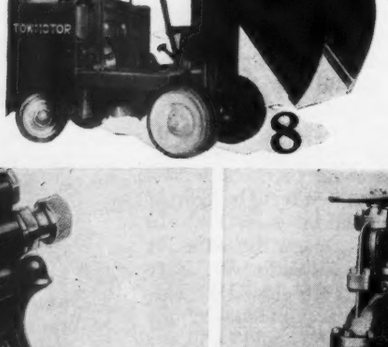
5 Electric Speed-Bloc Sander. Sterling Products Co., Detroit

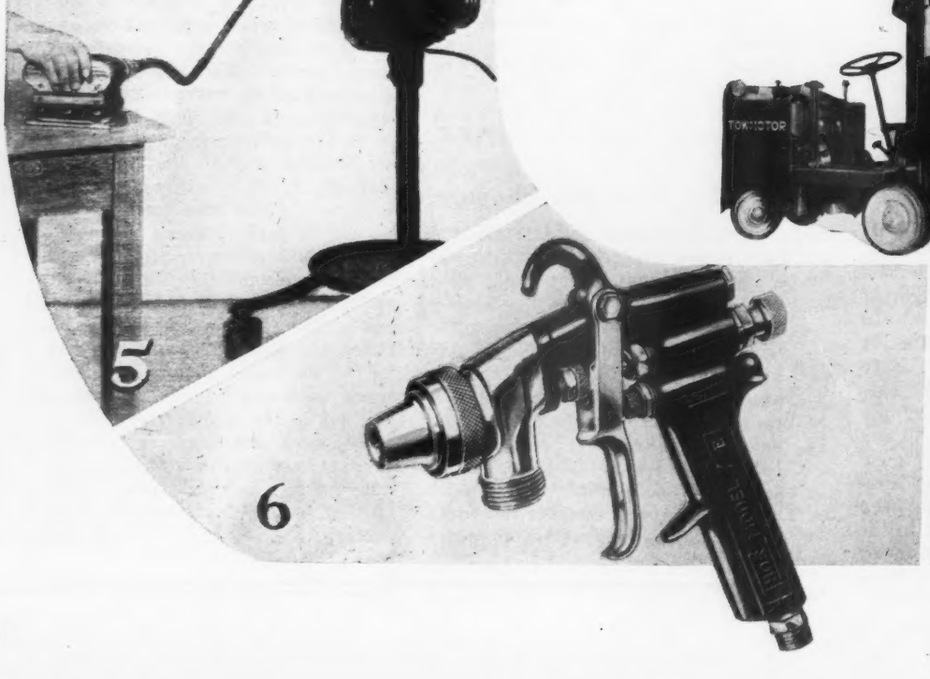
6 Spray gun for heavy materials. Binks Mfg. Co., Chicago

7 Wedge gate valve. The Kennedy Valve Mfg. Co., Elmira, N. Y.

8 Hydraulic-lift scoop truck. Towmotor, Inc., Cleveland







What's NEW in Equipment

Air Conditioning, Ventilating, Heating

DEHUMIDIFIER—Incoming air comes in contact with lithium chloride solution in cylinder. Moisture is absorbed by the solution, which is then regenerated in a second cylinder. Lamson Co., Syracuse, N. Y.

HUMIDITY CONTROL—Consists of solenoid water valve mounted on an insertion humidistat. For use on air ducts and unit-type air conditioners. Humidistat manufactured by Julien P. Friez & Sons, Inc., Baltimore; valve by Supreme Electric Products Corp., Rochester, N. Y.

INSULATION—DI Corkboard insulation for air ducts. Designed to prevent condensation. Is ½ in. thick and in 12- or 36-in. sheets. Armstrong Cork Products Co., Lancaster, Pa.

UNIT—"Number O." For cooling, dehumidifying, and filtering in summer and heating, humidifying, and filtering in winter. Uses any standard refrigerant; can be used with steam or hot water heating. Trane Co., La Crosse, Wis.

VENTILATOR—Can be started by wind velocity of 1 m.p.h. Inlet diameters range in 16 sizes from 8 to 72 inches. Capacities with wind velocity at 5 m.p.h. range 14,438 cu. ft. per hr. to 1,195,000 cu. ft. per hr. American-Larsen Co., Keystone Bldg., Pittsburgh.

Communication and Signaling

PRODUCTION CONTROL SIGNALS — Electric time and signal system designed to keep newspapers on schedule. Consists of self-regulating clock and three series of lamp and bell signals. Bells ring and lamps flash at predetermined times when different departments should have completed their tasks. International Business Machines Corp., 270 Broadway, New York.

SIGNALING EQUIPMENT — "Lokator." Spring-driven unit operates on 24-volt current. Small knob is moved to number to be called and pressed down there. Spring motor is then set by moving lever at right end of unit. Capacity of 20 calls. Edwards & Co., Exterior and 140th Sts., New York.

Electrical Control

RECLOSER—Type FP-19, 15-amp. oil circuit breaker recloser. Operates on oil-blast principle and is automatic and self-resetting. General Electric Co., Schenectady.

RELAY—"Capacitrol" relay for use where photoelectric apparatus may not be practical. Will handle non-inductive loads of 100 watts, heavier loads with auxiliary relay. When person or car approaches within 3 ft. of antenna, device operates. J. Thos. Rhamstine, Detroit.

STARTER—Type T, Class 8536 a.c. automatic motor starter. Line-voltage type; it can be used to start polyphase squirrel-cage motors directly across the line at full voltage. For remote operation of 7½- to 25-hp. motors. Square D Co., Milwaukee.

SWITCH—For lighting fixtures. Are 10-amp., 125-volt fixture and canopy switches. Said to be able to control 1,000-watt, gas-filled lamps. Are small, measuring only 1¾ in. in diameter and ⅞ in. thick. McGill Mfg. Co., Valparaiso, Ind.

SWITCH — "Silver Ball" high-tension switch. Rated: 2,000 amp., 7,500 volts. Adjustable and renewable silver contacts, lacquer-finished copper parts. Powercraft Corp., DeKalb St., St. Louis.

SWITCH—Type MB-139. Rated 34.5 kv., 600 amp. Post insulators. Medium-pressure-type, self-aligning contacts of large area. Mounts in upright, vertical, or inverted position. Delta-Star Electric Co., 2400 Block, Fulton St., Chicago.

VOLTAGE REGULATORS—Vibrating contact type. Has variable speed of vibration, adjustable over a wide range. Main contacts of platinum-iridium alloy. Burlington Instrument Corp., Burlington, Iowa.

Electrical Distribution

BUS — Square, seamless, copper-tube bus conductor designed to withstand heavy short-circuit stresses. Capacities of 1,500 to 6,500 amp. Chase Brass & Copper Co., Inc., Waterbury, Conn.

CONDUIT HANGER—Permits running of conduits parallel to beam or at right angles to it. Made of cadmium-plated, malleable iron. Two sizes: No. 470 for ½-, ¾-, or 1-in. conduit; No. 471 for 1¼- and 1½-in. conduit. May be used as ground clamp for Nos. 8 to 4 wire. Fullman Mfg. Co., Latrobe, Pa.

PANELBOARDS — Line of "Swing-Wa" panelboards for heavy duty feeder and power distribution applications. Consists of a number of individual inclosed sections. Opening of door disconnects circuit and gives access to fuses. The Trumbull Electric Mfg. Co., Plainville, Conn.

RELAY-TRANSFORMER — Combines low-voltage transformer and line-voltage relay. Suitable for line-voltage equipment with low-voltage control device. Rated at ½ hp. or 15 amp., a.c., 110 volts, 50 or 60 cycles. Russell Electric Co., West Huron St., Chicago.

TUBING—P-M-G metallic electrical tubing and rigid conduit. For hazardous and corrosive locations. Conduit in sizes from ¼ to 4 in., tubing in sizes ⅜ to 2 in. Lengths are 10 ft. Phelps Dodge Copper Products Corp., 40 Wall St. New York.

Electrical Protection Devices

CIRCUIT BREAKER — Multi-breaker load center. Consists of one or more small circuit breakers grouped in sealed molded housing and each capable of interrupting 5,000 amp. at 115 volts a.c. Westinghouse Electric & Mfg. Co., Pittsburgh, and Square D Co., Detroit.

CIRCUIT BREAKER—Type AE-1 air circuit breaker for heavy duty where many opening and closing operations are required. Interrupting rating of 20,000 amp. on circuits of 250 volts d.c. and 600 volts a.c. at 15-600 amp. General Electric Co., Schenectady.

CIRCUIT BREAKERS—Two indoor oil circuit breakers. Type F2-220 has interrupting capacities 500,000-2,500,000 kva., voltage rating 15 to 34.5 kv. Type F2-210 has interrupting capacity 250,000 kva. for 600, 1,200, and 2,000 amp. at 15 kv. Condit Electrical Mfg. Corp., Boston.

CIRCUIT BREAKERS—Type BD air circuit breakers. Hand or electrically operated. Interrupting rating: 40,000 amp., 600 volts. Sizes: 600 amp. and below, 600 volts a.c., 750 volts d.c. Roller-Smith Co., 233 Broadway, New York.

THERMAL RELEASE SWITCH — Gives overheating protection to motors of ⅛ to 1 hp. When internal temperature of motor rises above safe value for the winding, fusible alloy melts, breaking line circuit. Device is hand set. Leland Electric Co., Dayton, Ohio.

Electric Heating

HEATER—Automatic electric space heater for valve houses, fire extinguisher boxes, pump inclosures, and the like. Consists of heating element, control thermostat, thermometer, pilot light, and 3-in. outlet box. Rated at 500 watts, 110 volts, a.c. or d.c. Can be supplied for 220 or 440 volts. Rockwood Sprinkler Co., Worcester, Mass.

HEATER—Electric immersion heater made of "Vitreosil," a fused pure silica, which is said to be unaffected by acids other than hydrofluoric and phosphoric at high temperatures. Made to specifications. Thermal Syndicate, Ltd., 58 Schenectady Ave., Brooklyn.

Filtering, Clarifying, Mixing

DRIER—"Kreider Centrifugal Dryer." For drying all types of plated work. All-steel, welded frame with fully inclosed motor. Reversing drum-switch and footbrake. Standard basket is 12 x 12 in., rotates at 625 r.p.m. Dellinger Mfg. Co., North Prince St., Lancaster Pa.

MAGNETIC SEPARATOR—Type QF magnetic separator for purifying glazes, slips, and enamels. The slip passes through a cartridge consisting of many highly magnetized surfaces and placed between poles of powerfully energized stationary magnet. Stearns Magnetic Mfg. Co., Milwaukee.

SCREEN PLATE—Perforated screen plate with conical-shaped holes. Conical holes are supposed to eliminate clogging sometimes encountered with cylindrical holes. Opening of 0.01 to 0.02 in. can be supplied in hard or stainless steels. Abbe Engineering Co., 50 Church St., New York.

VIBRATING SCREEN — New sizes and types added to line of low-head, horizontal, vibrating screens. Available in single-, double-, and triple-deck designs in sizes up to 6 ft. wide. Allis-Chalmers Mfg. Co., Milwaukee.

Fire Protection

FIREDOOR—Self-closing, vertical-lift firedoor. Operating mechanism consists of one or more oil cylinders with piston rods connected to door or counterweight and supplied with oil by motor-driven pump. Fusible link when melted opens release valve. Closing can be at any desired rate. Cornell Iron Works, Inc., 3600 13th St., Long Island City, N. Y.

FIRE EXTINGUISHER—Working parts of Monel metal. Two sizes, 1 and 1½ qt. Uses "Fire Guard" extinguisher liquid. Liquid is distributed by pump action. General Fire Truck Corp., East Jefferson St., Chicago.

FIRE HOSE FABRIC—Cotton fabric for fire hose processed with rare earth metal salts having radioactive properties to cause it to resist mildew and make it moisture-repellent, rot-, and freeze-proof. Manhattan Rubber Mfg. Division of Raybestos-Manhattan, Inc., 33 Townsend St., Passaic, N. J.

Food

CEREAL PUFFER—For manufacture of puffed cereal products. Semi-automatic; has 1¼-hp. electric motor. Capacity is 115 five-oz. packages per hr. Fuel may be gas or gasoline. Nu-Vita Foods, Inc., Portland, Ore.

EVAPORATOR — Zeitler evaporator for milk, fruit juices, syrups, tomato products, etc. For continuous or batch operation in capacities of 2,000-20,000 lb. of water evaporation per hr. In stainless steel, nickel, or

other metals. Oakland Copper and Brass Works, Seventh St., Oakland, Cal.

WASHER—For cap-sealed beer cans. Gives four internal rinsings. Cans are loaded by chute or by dumping on loading table. Rotary feeding disk lines them up. In capacities up to 250 cans per min. Barry-Wehmiller Machinery Co., West Florissant Ave., St. Louis.

Grinding and Buffing

BELT GRINDER—"Variety" belt grinder and polisher. Grinds and polishes small and medium-sized metal pieces of irregular shapes. Takes belts up to 10 in. in width and 14 ft. long. Oliver Machinery Co., Grand Rapids, Mich.

GRINDER — No. 73 centerless cylinder grinder. Is claimed to produce to close tolerances and good concentricity. Furnished as plain machine with direct-reading dial indicator having diamond-pointed finger. Heald Machine Co., Worcester, Mass.

POLISHER AND BUFFER—Has three polishing or buffing heads, each with individual motor drives. Eight work spindles carried on circular head and advanced about vertical center. Two types and five sizes. Motor sizes range from ½ hp. at each head to 3 hp. Hammond Machinery Builders, Inc., Kalamazoo, Mich.

Instruments and Meters

AIR FILTER—No. 254 filter for use on air lines of air-operated instruments and controls. Air passes through a series of felt rings. Pressures up to 250 lb. and temperatures up to 100 deg. F. can be handled. Fisher Governor Co., Marshalltown, Iowa.

CO_2 METER—Operates on Orsat principle. Driven by fractional-horsepower electric motor. Requires no water for its operation. Caustic tank holds 4–6 months supply of potash. Filter removes SO_2 from the flue gas. Republic Flow Meters Co., 2240 Diversey Parkway, Chicago.

COMBUSTION INDICATOR—"Boiler Monitor HGL-5." Has pyrometer to measure boiler stack temperature and photoelectric cell unit with special gage to indicate density of combustion gases. Too great density flashes red light. Ess Instrument Co., 30 Irving Pl., New York.

CORE HARDNESS TESTER — Measures surface hardness of baked cores and dry sand molds. Dial indicator mechanism measures depth penetration of diamond cone point as tester is pulled across core surface. Harry W. Dietert Co., West Grand Blvd., Detroit.

FLOW CONTROLLER — Electronic flow controller for use with Rotameter flowmeter. Intended for use in automatically maintaining flow of liquids, vapors, or gas in piping systems at any desired fixed rate. Controller can be located at any distance from valve. Schutte & Koerting Co., North Twelfth St., Philadelphia.

FLUE GAS ANALYZER — "Orsatomat." Analysis can be made in 20 seconds by unskilled operator, it is claimed. Operator aspirates sample into instrument while it is in sampling position, pushes down rod to change instrument to analyzing position. takes reading from dial. The Hays Corp., Michigan City, Ind.

GAGES—Shockless gages with dials graduated 0-100 or 0-50-0 in hundredths of a millimeter or thousands of an inch. Diameter is 2¼ in. and maximum spindle travel is 0.3 in. B. C. Ames Co., Waltham, Mass.

OXYGEN METER—"Emco." Displacement-bellows-type gas meter for measurement of oxygen. For steel companies and other large users of oxygen. Withstands pressure of 200-500 lb. working pressure. Pittsburgh Equitable Meter Co., 400 North Lexington Ave., Pittsburgh.

PHASE ROTATION INDICATOR — For use on voltages 110-550, 25-125 cycles. Consists of small 3-phase induction motor mounted in plastic case and fitted with aluminum disk that indicates direction of rotation on 3-phase supply. Ferranti Electric, Inc., 130 West 42d St., New York.

pH METER—"Palo Acid-Alkalimeter." Determines pH directly, continuously, automatically. Measures pH from 0 to 14. Does not require skilled operator. Palo-Myers, Inc., 81 Reade St., New York.

PLATING SOLUTION CONTROLS — Three test kits designed to assist plater in keeping plating bath in most efficient condition. One for determination of cadmium in cadmium-cyanide solutions, one for zinc in alkali-cyanide or acid-zinc solutions, one for sodium-cyanide in zinc or cadmium solutions. Grasselli Chemical Co., Euclid Ave., Cleveland.

PYROMETER—A 2- and 3-position recording controlling pyrometer. Control is accomplished by movement of recording carriage with its ink stylus above or below the control contact assembly. Large scale. C. J. Tagliabue Mfg. Co., Brooklyn.

RECORDERS — Portable recording thermometer and operation recorder. Thermometer is bimetallic type in eight models in temperature ranges from —20 to +120 deg. F., —25 to +40 deg. C. Operation recorder comes in three models, in series and across-the-line types. Practical Instrument Co., North Ashland Ave., Chicago.

SOUND LEVEL METER—Measures noise quantitatively. Suitable for use near electrical machinery where stray magnetic fields are common. Calibrated to read in decibels above standard reference level of 10-16 watts per sq. cm. at 100 cycles. Range of 30-120 decibels. General Electric Co., Schenectady.

THERMOMETER—In seven standard commercial ranges. Scale is etched in the glass, case is one piece. H-B Instrument Co., North Broad St., Philadelphia.

TIMER—Series 75 CH timer. Knobbed dial is pulled out and turned to desired timing interval. After interval dial returns to zero. Rated at 15 amp., 125 volts a.c. or d.c. Walser Automatic Timer Co., 420 Lexington Ave., New York.

VOLTMETERS AND AMMETERS—Line of round-chart recording voltmeters and ammeters. Models for wall, switchboard, flush panel, and pole mounting, and for portable use. Aluminum alloy case. The Bristol Co., Waterbury, Conn.

WATTHOUR METER—Two-element, single-disk watthour meter. Compensated for all classes of temperature errors. Form V-2A for wall or connection-box mounting. form V-28 for socket mounting. General Electric Co., Schenectady.

WIRE AND ROPE METER—Model L-20 measuring meter for wire and rope production. Capacity up to 1½ in. in diameter and 5,280 ft. per min. Durant Mfg. Co., Milwaukee.

Lighting

LAMP — "Uni-focal" lamp gives uniform and intensive illumination over a restricted area. Has aluminum reflector which reflects light into a converging beam which comes to a focus 15 in. ahead of the reflector. There is a special supporting arm. Fostoria Pressed Steel Corp., Fostoria, Ohio.

REFLECTOR — All-white, porcelain-enameled inside and outside, indirect dome for bowl-silvered lamps. For either pendant or outlet-box mounting. Two sizes: 200 and 300-500 watts. Graybar Electric Co., Inc., 420 Lexington Ave., New York.

Lubricants and Lubricating Devices

OIL REFINER — Portable unit removes foreign substances, refines, purifies, crankcase oil. Oil passes in order through refining clay, a porous fibrous material, a special refining material, fine-mesh wire cloth. Luber-Finer, Inc., South Hope St., Los Angeles.

Materials

ALLOY—"Arcoloy." High-strength alloy used in manufacture of range boilers and storage tanks. Weldable by electric arc process. Consists of 95 per cent copper with silicon, phosphorous, and other elements added. American Radiator & Standard Sanitary Corp., 40 West 40th St., New York.

COLORS—Three. Calconese Brown R produces reddish brown shade. For cellulose acetate fibers. Calconese Blue MC produces dark brown and wine shades. Calcoloid Golden Orange 4RD Double is addition to line of dispersed vat colors. Calco Chemical Co., Inc., Bound Brook, N. J.

ELECTROPLATED TUNGSTEN—Process permits tungsten to be deposited in homogeneous combination with one or more other metals. Deposits are resistant to corrosion and other destructive factors. Tungsten Electrodeposit Corp., Barr Bldg., Washington, D. C.

PLASTIC—Heat-resistant plastic for moldings which must retain dielectric strength under high temperatures. Can stand temperatures up to 450 deg. F., it is claimed. Nos. 34 and 37, in black and brown. General Plastics, Inc., North Tonawanda, N. Y.

PLASTIC SHEET—Can be supplied as fully translucent sheet or with an opaque face over the translucent back. Can be curved. Four colors. Formica Insulation Co., Cincinnati.

TOOL STEEL—"EB" tool steel containing molybdenum and vanadium. Is claimed to maintain its hardness under high temperatures. Suitable for hot dies and cold forming. Ludlum Steel Co., Watervliet, N. Y.

Materials Handling

CAR—Industrial car with body riding on trunnions so that it can be removed and carried by crane. Capacities 27–54 cu. ft. Available for use on 18-, 24-, or 30-in. track. Made of steel plate. Koppel Industrial Car & Equipment Co., Koppel, Pa.

ELEVATOR—"Nordyke Service Elevator." Has steps and hand grips located at intervals along endless belt. Individual stands on step and holds grip while he is raised to higher level. Can be equipped with bag carriers. Allis-Chalmers Mfg. Co., Milwaukee.

PLATING RACK—"Quik-Rak" for chromium plating small parts. Has coating of rack enamel to prevent rack plating. Can also be used in nickel plating solutions by covering with rubber. The Kelly Plating Co., Madison Ave., Cleveland.

TANKS—Glass-lined storage tanks for milk, ice cream, etc. Propeller-type agitation. Entire core removable from outside for cleaning. Noiseless-drive motor. Agitator bushing is removable from outside. Pfaudler Co., Rochester.

TRUCK—All-steel barrel truck designed to handle steel or wood barrels up to 800 lb. in weight. Hoop fits down over barrel at top so that trucker does not have to touch barrel to lift it to carrying position. Barrett-Cravens Co., 3255 West 30th St., Chicago.

TRUCK—Hydraulic-lift scoop truck. Gasoline powered. Designed to handle bulk materials. Capacity is 9 cu. ft. and 4,000 lb. Driving wheels are under load. Powered by heavy industrial-type motor. Towmotor, Inc., 1233 East 152d St., Cleveland.

TRUCK—Scale-equipped, hand-lift truck. For foundries, chemical plants, food factories, and paper mills and other industries where there is a great deal of weighing to be done. After truck has been rolled under load, single stroke raises load into weighing position. The Yale & Towne Mfg. Co., Philadelphia.

TRUCK, LIFT—Model A-1002-12. Ram type. Drive is at front wheels, steering at the rear, and the operator rides in between. Capacity is 7,000 lb. with load measuring 36 in. in length. Maximum elevation above floor is 60 in. Mercury Mfg. Co., South Halsted St., Chicago.

TURNTABLE—For handling trucks. Diameter is 16 ft. Steel floor plates and structural cast steel frame. Mounted on 53-in. ball race at the center. Supporting rim at circumference rides on wheels mounted in foundation. Capacity is 16,000 lb. Easton Car & Construction Co., Easton, Pa.

UNLOADER — Automatic, remote-control unloader for unloading and conveying dry, pulverized materials. Operator stands at distance with control button in his hand and drives machine ahead or backs it up to dodge slides of the material. Fuller Co., Catasauqua, Pa.

NEW Equipment · Machinery · Materials · Supplies

WHEELBARROW — "Shovel-Barrow." Is cross between hand-shovel and wheelbarrow. Operator thrusts it against pile of loose material, then tilts it back. This operation is repeated as many times as necessary to fill the barrow. Shovel-Barrow Co., Chicago.

Mechanical Power Transmission

COUPLING—Flexible coupling. Has two-jaw, steel flanges machined to bear against adjacent sides of square center member. Wearing strips of non-metallic material take bearing pressure. American Flexible Coupling Co., Erie, Pa.

Metal Finishing

BRUSH—"The Lea String Brush" for use in conjunction with Lea method of metal finishing. Is more pliable than a cloth buffing wheel; hence it gets into contours of intricately shaped articles. Produces finishes from dull Satin to bright Butler. The Lea Mfg. Co., Waterbury, Conn.

Metal Working

BROACHING MACHINE — Model V-58 semi-automatic machine with normal working capacity of 50 tons. Supplied for pulling broaches upward but can be supplied for pulling them downward. Largest work diameter is 13 in.; 68 in. maximum length of broach. American Broach & Machine Co., Ann Arbor, Mich.

FORGING FURNACE—Slot-type unit for heating valve rods. Heats 5 in. of the ends of rods measuring ⅜ or ½ in. in diameter, up to 12 in. long. Burns either gas or oil. Conveyor speed sufficient to deliver about 3,000 rods per hr. Surface Combustion Corp., Dorr St., Toledo.

FOUNDRY FLASKS—Two slip flasks, one of aluminum, one of cherry finished on the inside with aluminum. Aluminum flask in sizes 12-30 in. in length, 9-20 in. in width, and 4-10 inches deep. Cherry flask is made to specification. Adams Co., Dubuque, Iowa.

HARDENING FURNACE—No. 2, model Y for hardening high-speed steel. Is muffle furnace with four heating elements. Heats from cold to 2,350 deg. F. in 70 min. it is claimed. Chamber dimensions: 4½ x 4 x 11 in. Sentry Co., Foxboro, Mass.

MILLING MACHINE — Heavy-duty, precision-type, hand milling machine. One-piece column supports slides for knee and cutter-head and serves for mounting the 1-hp. motor on the machine top. Producto Machine Co., Bridgeport, Conn.

MILLING MACHINE—No. 2-A double-end miller has chain-clamping mechanism for holding work under cut. Two cutter spindles, one carrying roughing cutter, other a finishing tool. Spindles can be adjusted while machine is in operation. Davis & Thompson Co., Milwaukee.

MILLING MACHINE—No. 10 plain milling machine. Full electrical control of all table and spindle movements. Designed for rapid manufacture of small parts on long or short runs. Sixteen spindle speeds from 55 to 1,800 r.p.m. Brown & Sharpe Mfg. Co., Providence, R. I.

PRESS—"No. A-3 Inclinable Press." Has 3-inch-diameter shaft. Has 14-point engagement sleeve clutch with built-in single-stroke mechanism, one-man inclining mechanism. Niagara Machine and Tool Works, Buffalo, N. Y.

Miscellaneous

CASTERS — Anti-friction truck casters. Equipped with Hyatt roller bearings. Bond Foundry and Machine Co., Manheim, Pa.

CHIPPER—A 50-in. chipper designed to handle sawmill refuse, slabs, edging, and small round pulp wood. D. J. Murray Mfg. Co., Wausau, Wis.

CLEANER—"Orthosil." An alkaline detergent for heavy duty cleaning operations. Cleans ferrous metals preparatory to painting, plating, or enameling. Comes as dry, white granules for solution in hot or cold water. Pennsylvania Salt Mfg. Co., Widener Bldg., Philadelphia.

DESCALING MACHINE — "Bullard-Dunn Electro-Chemical Process" for degreasing and descaling metals. Consists of one electrified treatment for removal of grease and dirt, followed by a second electrified process to remove scale. Bullard Co., Bridgeport, Conn.

DRIER—"Rotary Louvre Dryer" for drying all types of granular materials. Is a mechanically rotated horizontal drum with a series of internal channels near the circumference, into which hot air is admitted from a fan. Air mixes intimately with the charge. Link-Belt Co., 300 West Pershing Rd., Chicago.

FILLING MACHINE—No. 745 Doser. Delivers powdered material in measured amounts. Has aluminum hopper and vibrating attachment to assure complete delivery from the hopper. Aurelio Tanzi Engineering Co. 235 Fourth Ave. New York.

FILLING MACHINE—"Packomatic Packer-Weigher." Fills bags of 1 to 5 lb. capacity, but can be made for bags up to 12¼ lb. It can fill and weigh 5-lb. bags at rate of 18 to 20 per min. J. L. Ferguson Co., Joliet, Ill.

FILTER—Liquid filter. Has filtering cartridge through which liquid passes. Fitting threaded for ¾-in. pipe connections. Rate of flow at 50 lb. pressure is 5-10 gal. per min. Commercial Filters Corp., 89 Broad St., Boston.

FLOOR COVERING—Flexible rubber material for use on floors and walls. Said to be resilient, crack-proof, and stain-proof. It is ⅛ in. thick for floor application, 1/16 in. thick for walls. Widths of 33 and 36 in. Twenty-one colors. R-C-A Rubber Co., East Market St., Akron.

LABEL PASTER—"Whirlwind Electric Label Paster." Glue in covered pan at front is picked up on roller and applied in a narrow strip to labels as they are fed through machine. Can accommodate labels up to 18 in. in width. Scientific Filter & Machinery Co., 1 Franklin Sq., New York.

MELTING POTS—Nos. 1412 and 1414 wax melting pots. Made of aluminum with steel outer shell. No. 1412 has 400-watt current consumption, is 4 in. deep, has inside diameter of 4 in. No. 1414 consumes 750 watts, is 7 in. deep, 9 in. in diameter. Vulcan Electric Co., Broad St., Lynn, Mass.

MILL—For grinding chemicals. Is cone-type mill with toothed cone revolving within a second toothed cone. Grinding parts of cast iron but can be had in stainless steel. Drive is by ¾-hp. motor, driving grinder at 1,160 r.p.m. F. J. Stokes Machine Co., Philadelphia.

PACKING—"Lockring" seal for Freon, ammonia, oil, or water. Rings of soft metal cushioned with asbestos laminated and molded and vulcanized at high temperatures to withstand heat and oil action. Williams Gauge Co., Pennsylvania Ave., N. S., Pittsburgh.

PACKING MACHINE—"No. 41 Vibrox." Improved design of machine to impart vertical and horizontal vibration to compact materials. Capacities of 100–750 lb. One-hp., 1,140-r.p.m. motor is used. Platform measures 20x22 in. B. F. Gump, South Clinton St., Chicago.

PRESSURE TANKS—Type S. Can be used for any type material that does not require a tank with removable cover for cleaning. For working pressures up to 100 lb. In 15-, 30-, 60-, and 100-gal. sizes. Binks Mfg. Co., 3114 Carroll Ave., Chicago.

PROTECTIVE COATING — "Lubriguard." It protects delicate parts against oil creepage. Applied to parts after they have been cleaned; then parts are baked for a few minutes. Mann Instrument Co., Cambridge, Mass.

RECTIFIER—"RectiFilteR." Supplies stabilized d.c. from a 110-volt a.c. source to operate telephones, clocks, bells, fire alarms. Can be used for continuous service. Raytheon Mfg. Co., Waltham, Mass.

SOUND DAMPENING DEVICE—"Floated drive bracket." For sound and vibration dampening on direct-connected blowers. Can be obtained as original equipment on any Ilg types B or BC direct-connected universal blower or can be mounted on blowers in the field. Ilg Electric Ventilating Co., 2865 North Crawford Ave., Chicago.

WATER STERILIZER — Hartman Ozone Water Sterilizer." New design made of stainless steel, except for pipe and fittings which are of acidproof bronze, chromium plated. Norwood Filtration Co., Florence, Mass.

WINDING MACHINE — Winds bobbins, coils, and armatures. Consists of pedestal unit housing motor and a winding unit which can be detached for bench use. E. R. Seifert, Inc., Syracuse, N. Y.

Motors

MAGNET BRAKE—Type CR 9523 band-type, three-valve, spring-set, d.c. magnet brake. For use where a load must be held at motor armature. Adjustable, self-aligning brake shoes. General Electric Co., Schenectady.

MOTORS — Riveted-frame, squirrel-cage, polyphase induction motors in sizes of 1–15 hp. at 1,800 r.p.m. Feature improved design in stator-coil insulation, frame construction. General Electric Co., Schenectady.

Paint and Painting Equipment

ENAMEL—"No. 05730 One Coat Locker Enamel." Gives tough, durable finish on lockers, cabinets, files, and the like. In spraying or dipping types. Baked at temperatures of 260–280 deg. F. Grand Rapids Varnish Corp., Grand Rapids, Mich.

PAINT—"Rust-Nutro." To be applied on rusty surfaces. Converts rust into part of the paint pigment. Claimed to be resistant to acids, alkalis, and corrosive agents. Armor Laboratories, Inc., San Fernando St., Los Angeles.

PAINT MIXER—Power agitating paint mixer for mixing coating materials in drums and barrels. Can be adapted to any standard lacquer or paint barrel or drum. Employs air motor. Binks Mfg. Co., 3114 Carroll Ave., Chicago.

SPRAY GUN—Thor Model 7E spray gun for asphalt and other heavy materials. Can be furnished with round or flat nozzles in four different sizes. Binks Mfg. Co., 3114 Carroll Ave., Chicago.

SPRAY GUN CONNECTIONS—Two spray guns designed to give closer control, better balance, and faster production in spraying operations. T-784 brings air and material connections together at bottom of gun handle. T-785 brings the two together at bottom and back of the gun. Binks Mfg. Co., 3114 Carroll Ave., Chicago.

Piping, Valves and Fittings

PIPE—Centrifugally cast stainless steel pipe. In outside diameters from 2 to 22 in., wall thicknesses from ⅛ in. up. Michigan Steel Castings Co., Detroit.

VALVE—"Atlas" tandem blow-off valve for steam pressures up to 1,800 lb. per sq. in. Contains two valves in one body. In sizes of 1¼, 1½, 2 and 2½ in. for 250–600 lb. pressures; sizes of 1½, 2, 2½ in. for 900–1,500 lb. Clees Valve & Engineering Co., 90 West St., New York.

VALVE—Fig. 97 standard solid-wedge, slip-on, disk-type gate valve with rising stem. For steam, water, oil, and gas. Made of bronze. Can be packed under full pressure. The Ohio Injector Co., Wadsworth, Ohio.

VALVE—Freyn-Fahrite non-cooled furnace valve. Has heat-resisting, alloy-steel seat and gate inclosed above floor level with a steel plate housing on which is mounted an integral, motordriven operating mechanism for raising and lowering gate. Freyn Engineering Co., South Michigan Ave., Chicago.

VALVE—Work ejector valve for punch and stamping presses. Valve cage is cast bronze with standard-thread inlet and outlet; cam roller bracket is also bronze; body is of stainless steel. Action of roller against cam lever actuates valve. C. B. Hunt & Son, Salem, Ohio.

VALVES—Line of standard iron-body wedge gate valves. Metal is of very dense structure and bodies are of oval section to insure strength. In all standard sizes from 1½ in. to 60 in., for steam working pressures of 150 lb. and water pressures of 200 lb. The Kennedy Valve Mfg. Co., Elmira, N. Y.

Portable Power Tools

SANDER — Electric Speed-Bloc Sander. Driven by electric motor through flexible shaft. Sanding action is reciprocal with 5/32-in. travel of sanding pad. Special construction makes machine applicable to both curved and flat surfaces. Sterling Products Co., 314 East Curtis Bldg., Detroit.

Power Plant Equipment

BOILER FEEDER—Direct-pressure boiler feeder for boilers up to 100 sq. ft. Handles both condensation and make-up water. Claimed to save in pure water and steam. Morehead Mfg. Co., Detroit.

BOILER PLUG—Plug for repairing small boiler leaks. Consists of long screw, cup washer containing plastic packing, nut, and expander strip. Expanded strips anchor bolt, and plastic packing seals the hole. Croessant Machine Works, Moss St., Reading, Pa.

BOILER SCALE REMOVER—"Elek-Trol-Ik." Material in metal box with perforated ends sets up electrolytic action in fire-tube boilers. Box is clamped on top row of tubes. The action is said to assist in ridding boiler of scale and preventing further formation. Oneida Electric Mfg. Co., Green Bay, Wis.

CONDENSING UNIT—Type CM-122L unit. Has 40-hp. motor, a.c. or d.c., is rated at 514,000 B.t.u. per hr. with cooling water at 75 deg. F. and water consumption of 3,880 gal. per hr. Freon refrigerant, belt-driven, V-8 compressor. General Electric Co., Schenectady.

ECONOMIZER—Type EX extended-surface economizer. Consists of 2-in. steel tube on outside of which are sunk a series of cast iron rings. Pressure joints are outside gas passage so that water can be drained from economizer without shutting down boiler. Green Fuel Economizer Co., Inc., Beacon, N. Y.

PUMP PRIMER—Removes air from suction line by means of air release valve mounted at top of centrifugal pump casing and connected to vacuum tank from which air is exhausted by motor-driven vacuum pump. Valve & Primer Corp., Conway Bldg., Chicago.

SAFETY VALVE—Type 1690 safety valve for compressors, gas lines, and the like. Ten capacities from 25 to 250 lb. Can be used with temperatures up to 150 deg. F. Four sizes from ¼ to ¾ in. Consolidated Ashcroft Hancock Co., Bridgeport, Conn.

SUPERHEATER—Delivers steam at specified temperature regardless of operating variations in CO_2 and soot accumulation. Can be designed for low pressure drop. Regulation by automatic thermostatic valve. Controlled Heat Equipment Co., Dime Bank Bldg., Detroit.

Rubber Working

BRANDING EQUIPMENT—Tire numbering and branding equipment. Numbering disks, with numbers from 0 to 9, can be had in three sizes, as can letter disks. Both electric- and gasoline-operated disks available. Everhot Mfg. Co., Maywood, Ill.

VULCANIZING MOLDS—Line of 16-in. contour, 1-, 2-, and 3-cavity, sectional tire vulcanizing molds. Have aluminum in the bead plates and insure even heating temperature. Akron-Williams Division, Hilyard-Newbold Co., Norristown, Pa.

Safety Equipment

GLOVES—Double-palm, cross-quilted construction with cuff inscribed "Safety First—Be Careful." Buff is short to prevent its catching in machinery. Supreme Mfg. Co., 217 Ninth St., Pittsburgh.

GOGGLE—"F-3105 Ful-Vue Goggle." High-up endpieces, self-adjusting nose pads, Super Armorplate lenses, side shields of non-corrosive, easily cleaned wire-mesh screen. Metal frame is also non-corrosive. American Optical Co., Southbridge, Mass.

HELMET—"Code SB-100" sand-blast helmet. Has duralumin head assembly, form-fitting cape, internal air supply. Supply hose attached to valve mounted on worker's belt. B. F. McDonald Co., South Hope St., Los Angeles.

LADDER SHOES—One-piece rubber ladder shoes with vacuum cup bottoms designed to prevent ladders from slipping. Johnson Ladder Shoe Co., Eau Claire, Wis.

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(Continued on page 90)

NEW Equipment · Machinery · Materials · Supplies

Truck illustrated made by The Elwell Parker Electric Company

Production moves smoother and faster when Exide-Ironclads help to handle materials . . .

THERE is no more willing and tireless and economical worker than an electric industrial truck equipped with Exide-Ironclad Batteries. You can load it up and keep it busy from the start to the end of the day. It needs no rest periods, requires no servicing throughout the day's operation. It speeds up the handling of materials and smooths out the entire process of production.

You are sure of these advantages when your units are powered with dependable Exide-Ironclads. With their high power ability, high electrical efficiency, extreme ruggedness, and long life, these batteries have the four essential characteristics for fast, efficient material handling service.

Exide-Ironclads save money by minimizing maintenance, by their trouble-free performance and by the long, faithful service they deliver. Why not improve your own material handling service and cut costs with Exide-Ironclads? Write for free booklet, "The Efficient, Economical Method of Handling Material."

THE ELECTRIC STORAGE BATTERY CO., Philadelphia
The World's Largest Manufacturers of Storage Batteries for Every Purpose
Exide Batteries of Canada, Limited, Toronto

VALVES—Line of standard iron-body wedge gate valves. Metal is of very dense structure and bodies are of oval section to insure strength. In all standard sizes from 1½ in. to 60 in., for steam working pressures of 150 lb. and water pressures of 200 lb. The Kennedy Valve Mfg. Co., Elmira, N. Y.

Portable Power Tools

SANDER — Electric Speed-Bloc Sander. Driven by electric motor through flexible shaft. Sanding action is reciprocal with ⅝-in. travel of sanding pad. Special construction makes machine applicable to both curved and flat surfaces. Sterling Products Co., 314 East Curtis Bldg., Detroit.

Power Plant Equipment

BOILER FEEDER—Direct-pressure boiler feeder for boilers up to 100 sq. ft. Handles both condensation and make-up water. Claimed to save in pure water and steam. Morehead Mfg. Co., Detroit.

BOILER PLUG—Plug for repairing small boiler leaks. Consists of long screw, cup washer containing plastic packing, nut, and expander strip. Expanded strips anchor bolt, and plastic packing seals the hole. Croessant Machine Works, Moss St., Reading, Pa.

BOILER SCALE REMOVER—"Elek-Trol-Ik." Material in metal box with perforated ends sets up electrolytic action in fire-tube boilers. Box is clamped on top row of tubes. The action is said to assist in ridding boiler of scale and preventing further formation. Oneida Electric Mfg. Co., Green Bay, Wis.

CONDENSING UNIT—Type CM-122L unit. Has 40-hp. motor, a.c. or d.c., is rated at 514,000 B.t.u. per hr. with cooling water at 75 deg. F. and water consumption of 3,880 gal. per hr. Freon refrigerant, belt-driven, V-8 compressor. General Electric Co., Schenectady.

ECONOMIZER—Type EX extended-surface economizer. Consists of 2-in. steel tube on outside of which are sunk a series of cast iron rings. Pressure joints are outside gas passage so that water can be drained from economizer without shutting down boiler. Green Fuel Economizer Co., Inc., Beacon, N. Y.

PUMP PRIMER—Removes air from suction line by means of air release valve mounted at top of centrifugal pump casing and connected to vacuum tank from which air is exhausted by motor-driven vacuum pump. Valve & Primer Corp., Conway Bldg., Chicago.

SAFETY VALVE—Type 1690 safety valve for compressors, gas lines, and the like. Ten capacities from 25 to 250 lb. Can be used with temperatures up to 150 deg. F. Four sizes from ¼ to ¾ in. Consolidated Ashcroft Hancock Co., Bridgeport, Conn.

SUPERHEATER—Delivers steam at specified temperature regardless of operating variations in CO_2 and soot accumulation. Can be designed for low pressure drop. Regulation by automatic thermostatic valve. Controlled Heat Equipment Co., Dime Bank Bldg., Detroit.

Rubber Working

BRANDING EQUIPMENT—Tire numbering and branding equipment. Numbering disks, with numbers from 0 to 9, can be had in three sizes, as can letter disks. Both electric- and gasoline-operated disks available. Everhot Mfg. Co., Maywood, Ill.

VULCANIZING MOLDS—Line of 16-in. contour, 1-, 2-, and 3-cavity, sectional tire vulcanizing molds. Have aluminum in the bead plates and insure even heating temperature. Akron-Williams Division, Hilyard-Newbold Co., Norristown, Pa.

Safety Equipment

GLOVES—Double-palm, cross-quilted construction with cuff inscribed "Safety First—Be Careful." Buff is short to prevent its catching in machinery. Supreme Mfg. Co., 217 Ninth St., Pittsburgh.

GOGGLE—"F-3105 Ful-Vue Goggle." High-up endpieces, self-adjusting nose pads, Super Armorplate lenses, side shields of non-corrosive, easily cleaned wire-mesh screen. Metal frame is also non-corrosive. American Optical Co., Southbridge, Mass.

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Conveyor Assembly Keeps a Plant on Its Toes

(Continued from page 51)

plate notched to the widths of the various engines. The hoist operator (he also performs some assembly operations) merely slips the rings on the pipes into the proper notches, getting the right span before hooking on.

Large parts and subassemblies are fed to the engine line by mechanical handling, specially adapted in each instance to the particular requirements of the task. An interesting example comes with the teaming together of two monorail and hoisting set-ups for handling the fuel pump housing assembly. This assembly comes from the California plant, and as it approaches the engine assembly line it is in a crate without a top. It must be removed from the box for installation of the fuel filter, and the unit must be delivered to the engine assembly line at the proper point.

The assembly is picked from its shipping crate by an air hoist mounted on an L-shaped overhead monorail. It is pulled a few feet around the corner and laid down at the point where the filter goes on. Now with this operation completed, it is ready to go to the engine assembly line some fifteen feet distant.

Right here another monorail comes within a very few inches of the L-shaped section referred to above. This second monorail is laid out as a rectangle (with rounded corners, of course) and carries four chain falls. The complete subassembly is picked up on the chain fall, pushed toward the diesel line. When the subassembly has been removed, the empty unit is pushed on around the rectangular monorail track, and presently is back for another load.

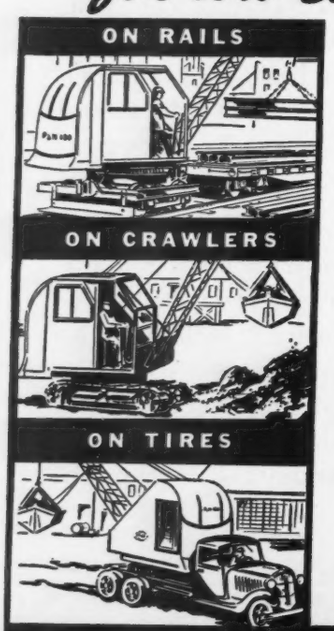
Changes in work level along the line are adjusted for by a platform constructed according to the height of the task, upon which the workers stand. However, this platform avoids the falling hazard so prevalent in places of this sort. The front of the platform is flush with the assembly conveyor, unless it is closer to the floor than the conveyor. The back of the platform is almost solidly lined with bins, racks, banks of lift-truck skids loaded with large parts. Where no such barrier exists, a small single-rail fence of two-by-fours prevents the workers from stepping off backwards.

10-Ton Crane Does the Lifting

When the finished engine comes to the end of the assembly line, it still lacks pump, filter, and oil pan. The engine is lifted with a 10-ton crane, serving the end bay of the building. This crane sets down the engine on a run-in block equipped with a common oil pan and served by an oil-circulation and oil-filtering system which works for the entire department. At first the engine runs off the power of the adjacent engine; then when that engine is removed, it in turn runs the new engine that goes upon that block. Only after the run-in are the oil pump, pan, and filter attached and the engine hauled away by crane along a railway to the final tractor assembly line, or if the engine is for detached service, to a department where it is prepared for its job.

Even at the moment of putting on the oil system, an interesting handling method is employed. The engine, when it comes off the run-in block, is laid in a cradle on rockers. It is then rotated over on its side by an electric motor with stop-and-start buttons and reducing gear. Here it remains long enough to put

P&H "SWITCHER CRANE"
for low cost Spur Handling



It's a great, little unit that does two big jobs—moves freight cars and handles all kinds of materials. Self-propelling on standard rail wheels, it pulls from two to seven freight cars, depending upon loads. The light 25-foot boom gives you a wide working range with hook, clam-shell or magnet. It cuts car switching costs, saves time, reduces your investment in handling equipment. Ask for full information about the "Switcher Crane."

HARNISCHFEGER CORPORATION
Established 1884
4525 W. National Ave. Milwaukee, Wis.

P&H CRAWLER-TRUCK & "SWITCHER" CRANES

on the oil system; then it is rotated back to an upright position.

It would be possible to detail a great many more facts on this diesel assembly line, but the facts here outlined should be sufficient to indicate to many another manufacturer some ways in which he might profitably employ mechanically moved assembly lines and mechanical handling in some of his operations, no matter how different the applications. To quote the production executive in charge of the plant of which the engine assembly is one part:

"A motor-driven assembly line—man, that's the way to get your plant synchronized and your costs down! We had our reasonable reservations when we were laying out this line. We sometimes wondered whether it would really work out as well as it was planned to. It worked out so much better than our plans that we can hardly believe it. And one thing we are convinced of, after this really critical test of the idea—there is just one good way to turn out a mass-production assembly job, and that is by using a mechanically moved assembly line."

Strategy Says Six Stockrooms

(Continued from page 53)

2) according to the code number of the scale to be assembled. He does this from sheets supplied by the engineering department. These sheets give a complete list of parts going into the kind of scale that has been ordered. Each part, it will be seen, has a symbol number and a drawing number, plus a description so that there can be no question as to what it is.

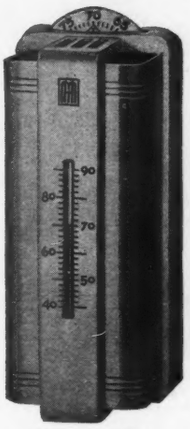
In the production office there is a series of "tubs," circular files about six ft. in diameter and placed on pedestals at about the height of an ordinary table. They are pivoted at the center so that a clerk sitting beside one of them may select any of the cards which they contain without getting up. There is a tub for each class of scales and a card for each part. The cards carry symbol, drawing number, and other details. Parts on hand are also shown. In other words, a perpetual inventory is kept at this point of all parts of all products.

If all the parts required for the order are on hand the storekeeper of the department involved is notified to deliver them to the proper

DEVILBISS EQUIPMENT

Spray-Finishes for

Minneapolis-Honeywell Regulator Co.



Minneapolis-Honeywell "Acratherm"

As evidenced by the experience of leading manufacturers in widely varied fields, you can economize in your finishing department, and at the same time improve the appearance of your product.

DeVilbiss Spray-Finishing Equipment speeds up finishing operations, saving both time and labor and reducing production costs. It produces a beautiful, high quality finish which imparts a greater selling appeal to your product. Consider DeVilbiss Spray-Finishing and Exhaust Equipment for your use. You, like the thousands of manufacturers who have standardized on it, can expect one hundred per cent satisfaction from its use.

THE DEVILBISS COMPANY · TOLEDO · OHIO

New York *Philadelphia* *Cleveland*
Detroit *Chicago* *St. Louis*
San Francisco *Windsor, Ontario*

Direct sales and service representatives available everywhere

DeVilbiss

Comp'nies, *'Tenshun!*

Here are the real Doughboys *of* American Industry

Why do you think whole regiments of these trucks stand at attention each morning in the yards or warehouses of thousands of plants? Greater ease and efficiency in handling is one of the reasons. Greater economy through lower mortality rate is another.

Stevedore TRUCKS

One of a complete line of American Hand Trucks designed for every type of work.

These Trucks Push Their Way to Profits

Strength and light weight combine to make American Hand Trucks the most efficient type built today. Fabricated of modern steel in place of wood, their light weight is a matter of "feel" as well as actual poundage. This is due to perfect balance which enables the handler to transport the heaviest loads with surprising ease. Translated into dollars and cents, investment in these trucks definitely makes payrolls more productive.

The labor saving, floor-saving, rubber-tired, roller-bearing "American" hand truck wheel.

Superior wheel equipment in pressed steel and semi-steel is an American Hand Truck feature. Goodyear P. S. C. Rubber Tires, Timken or Hyatt Roller Bearings are standard when purchasers desire superlative equipment. Write for catalog and price list showing the variety of designs—each one tested and proven efficient for specific handling needs.

THE AMERICAN PULLEY COMPANY
4200 Wissahickon Avenue, Dept. 4, Philadelphia, Pa.

AMERICAN
PRESSED STEEL
HAND TRUCKS

point. If the parts are not all on hand the production department sends an order to whatever department supplies the parts required, which more often than not is the rough castings department. However, the order might be to the purchasing department, the foundry, or some other department. Of course with those products that move fast care is taken to see that there are always sufficient parts on hand. But for other types of scales sold only occasionally and not for quick delivery there is usually no serious objection to waiting until some of the parts are manufactured. When the parts have finally been gathered together at the finished stock room they are issued to the proper foreman for assembly.

Cash for Plant Replacements?

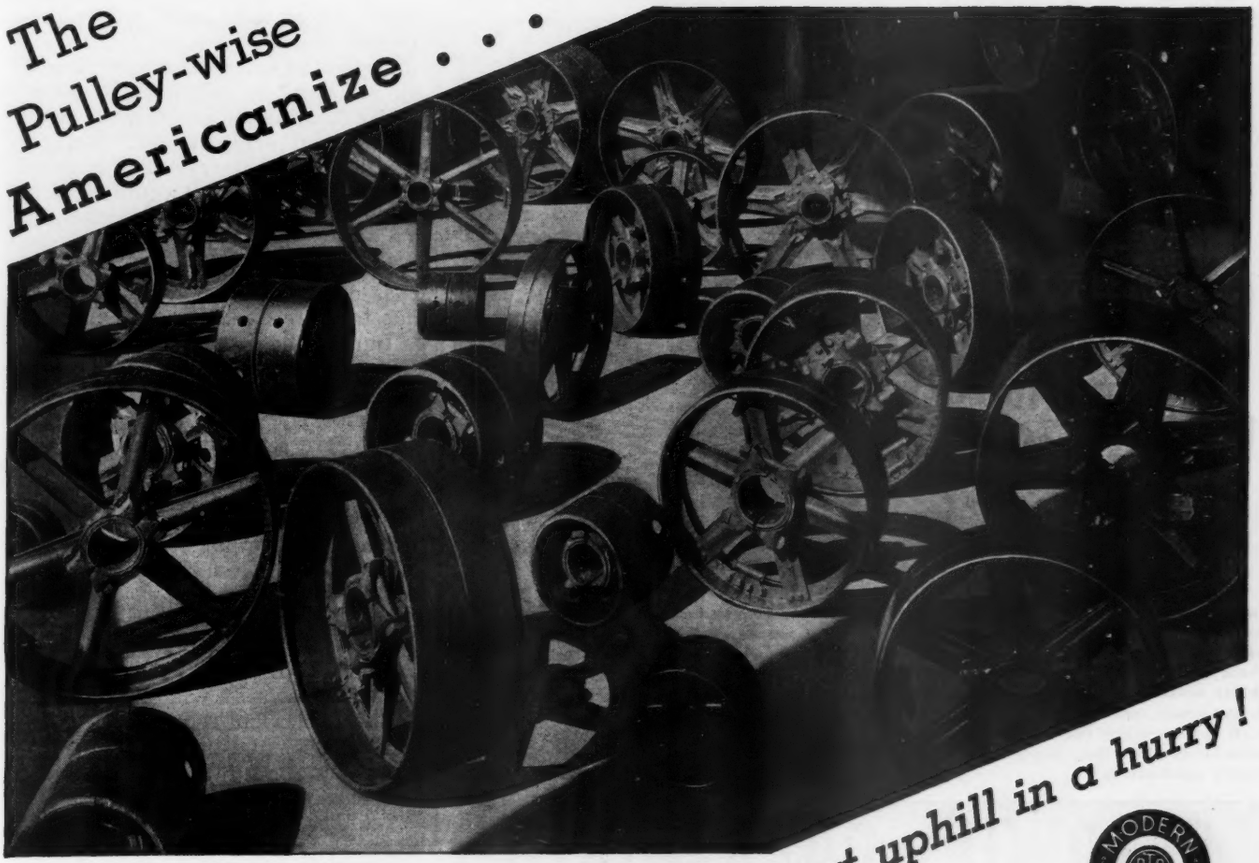
(Continued from page 54)

few large units would require irregular replacements of large amounts; an extensive distribution system would call for constant replacements of fairly uniform amounts. Conditions vary from plant to plant, but for industry as a whole machinery and equipment (which require constant replacement) are relatively more important than buildings (which require irregular replacement).

Some of the limitations on the opposing positions taken as to replacement funds now appear. Mr. Strangman in using a building as his illustration was apparently influenced by a feeling that the "one-hoss shay" type is the more important. Certainly a warehouse company or a utility operating company with a single unit generating station ought to give serious consideration to his views. In such plants annual replacements are likely to be very high or very low. But most plants are composed of something other than a building and a limited number of expensive machines. As the number of plant items increases, annual replacements will tend to become more uniform and the problem of financing replacements will be greatly simplified since assets retained in the business by the depreciation charges will take care of the situation.

Other factors must be considered. Perhaps the most important is that no plant can be or should be maintained in a state of complete newness. Such a state would have to result if funds equal to the depreci-

The Pulley-wise Americanize . . .



and manufacturing profits start uphill in a hurry!

MODERN GROUP DRIVE

The Power Wise Group Their Drives

Of course, power must always remain an expense item in determining production cost. But, according to transmission engineers, the difference between efficiently and poorly conveyed power can make a vast change in your annual profit picture.

Progressive plant managers notice an immediate change when Modern Group Drives are employed. Coupled with the installation of American Steel Split Pulleys, they are obtaining maximum power with minimum outlay. This is not idle boast but scientific engineering fact.

American Steel Split Pulleys have definitely demonstrated economies in operation. They require less power to start because they are lighter . . . less power while running because they are perfectly balanced, true and designed to reduce resistance by cutting the air.

The advantages of split construction, interchangeable bushings, superior strength and lightness all contribute toward savings that you can not afford to overlook. Let us send descriptive literature at once. Then decide for yourself.

AMERICAN
PULLEY COMPANY
4200 WISSAHICKON AVE. PHILADELPHIA, PA.

The Perfection stoker uses Baldwin-Duckworth triple width roller chain between 1200 R.P.M. electric motor and gear reduction unit. Drive shaft is operated by single roller chains.

For ECONOMICAL PERFORMANCE use Roller Chain

To operate economically, this stoker must receive a steady, uninterrupted flow of power. And Baldwin-Duckworth roller chain furnishes the strength and dependability demanded by the job. The multiple strand chain operates on short centers at high speeds—while the single strand chain withstands the slow, heavy drag of the stoker mechanism.

Wherever economy depends upon trouble-free power delivery—use Baldwin-Duckworth precision machined roller chain. Rugged and accurate, it gives longer life with fewer repairs.

Send for a copy of our catalog. It shows all types of roller chains and accurate cut sprockets. Baldwin-Duckworth Chain Corporation, Springfield, Mass.

BALDWIN—DUCKWORTH

2 weeks trial gratis!

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The Ferranti DUAL RANGE CLIP-ON AMMETER

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ation charge were spent on replacements without expansion. Successful operations are commonly carried on in plants on which there is accrued depreciation of 15 to 35 or 40 per cent of original cost. This is possible because serviceable lives of different plant units differ, and amounts of accrued depreciation applying to individual items will range from nothing on items just purchased to 100 per cent on those due to be retired.

During the early years of operation, replacements will be small, but as time goes on will tend to increase. If funds equal to the depreciation charge are set aside from the very beginning, a considerable fund will be accumulated, a fund that will continue to increase until annual replacements approximate the depreciation charge. Even though the plant contains an element of buildings that require replacement at long intervals, an important portion of the fund will never be used (since complete newness will never again be attained), and segregation of assets in such a fund renders those assets sterile to the extent of the unusable portion.

Another factor is a question of financial policy. In Mr. Strangman's illustration of a building he states that "without the plant replacement fund, however, it is probable that a considerable portion would have been distributed to the shareholders in the form of dividends, and much might have been spent for betterments and improvements to the plant." Of course the payment of dividends would depend upon the existence of a previously earned surplus, for disbursement of dividends on any other assumption would entail depletion of capital.

Debatable Problem

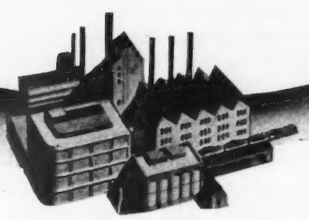
Yet expansion (and Mr. Strangman might have added debt retirement) is quite possible. Whether or not funds obtained through depreciation should be used for this purpose (with a requirement if the funds are thus used of borrowing or additional investment at the later date of replacing the building) is a debatable problem. If money rates on suitable investments for a depreciation fund are sufficiently less than the borrowing rate, immediate use of depreciation funds and subsequent borrowing may be called for as the cheapest policy. The extra interest cost in the interval before replacement plus the possibility of unfortunate investments will outweigh the contingency of an unfavorable money market when funds must be obtained for replacement

FOR NEW OR EXISTING BUILDINGS

there is New *Economy* and *Efficiency* with

Carrier

Space Heating



THE longer you put up with direct radiation, pipe coils and other old-fashioned methods of heating—the more it costs you. Time and again, the installation of Carrier Heat Diffusers or Unit Heaters has paid for itself in a single season—not only in better working conditions but in actual cash savings. And time and again, their installation has made it unnecessary to revise completely the existing heating system.

For Carrier space heating is *modern* heating, designed to provide maximum heating efficiency at minimum cost of installation and operation. The high velocity at which air is discharged not only assures uniform heat, it also directs heat exactly where needed—the working zone. Automatic control maintains uniform temperatures at all times — eliminates wasteful over-heating. And because of their sectional construction, Carrier Heat Diffusers and Unit Heaters can be readily adapted to your particular requirements, can be moved from one building to another, should the need arise.

Efficient heating is just as much a matter of handling and controlling air as is product conditioning, product cooling and air conditioning. You get the engineering skill and experience responsible for countless Carrier* installations in every part of the world, when you turn your heat distribution problems over to Carrier.

Your local Carrier dealer will gladly inspect your plant without obligation, show you how—whether you heat with steam or hot water—Carrier Heat Diffusers or Unit Heaters can improve working conditions, reduce heating costs during the coming winter. Why not phone him today? Or mail coupon.

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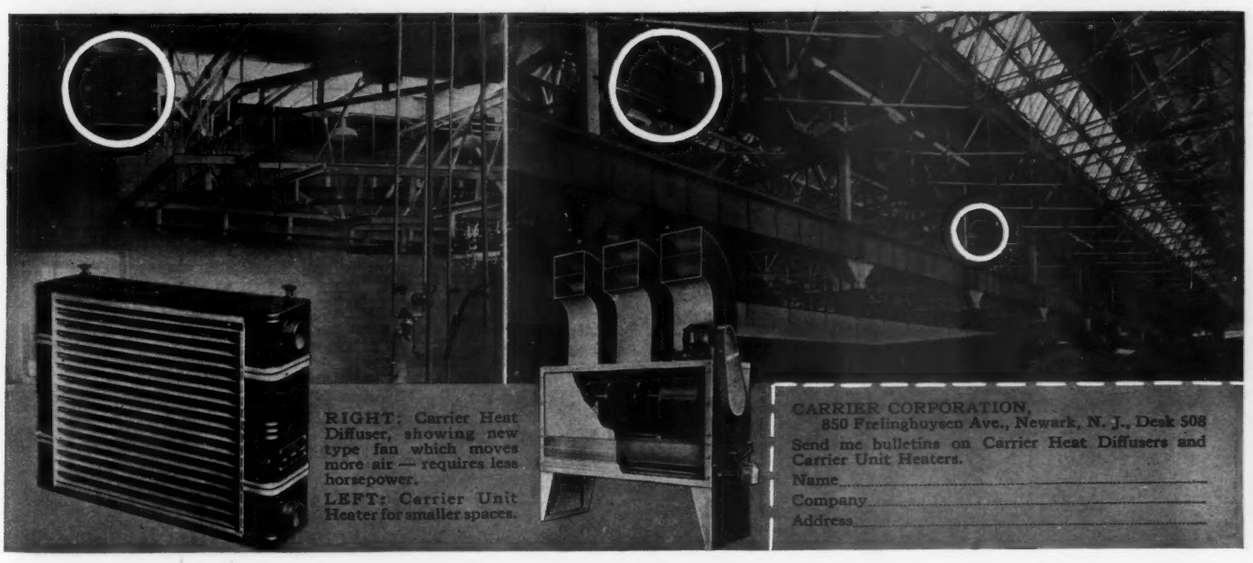
*Willis H. Carrier, in 1911 founded the art of air conditioning when he disclosed his now-famous Psychrometric Formulae to the American Society of Mechanical Engineers and began making air conditioning installations.



RIGHT: Carrier Heat Diffuser, showing new type fan which moves more air — requires less horsepower.

LEFT: Carrier Unit Heater for smaller spaces.

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Increase health and efficiency

Recover valuable material from the air

Keep machines and equipment clean

cutting down labor and dust-caused machine inefficiency.

Choose the filter that matches your needs — either Dry-Type (the one fully automatic, self-cleaning dry-type filter) or Unit Type. Both are furnished you in exactly the efficiency you want—eliminating up to 99% 2 micron (0.00008″) dust.

Bulletin F - 350 - 1 gives full details on the Dry-Matic; Bulletin F-320-3 on the Unit Type. Write for your copies.

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purposes. The problem is to find the most desirable and profitable use for all funds under the control of the business, regardless of their source.

Any attempt to substitute mechanical rules for judgment is doomed to failure. The problem under discussion is a financial problem of many phases. No more than an outline of limiting conditions is possible—or desirable. It is not the task of the accountant to dictate financial policy by accounting techniques. Mr. Strangman recognizes this when he says that "in any case the fund built up is at the disposal of the board of directors." The financial executives must realize that, as the type of plant approaches the "one-hoss shay," careful planning is essential to meet irregularly large replacements.

In extreme cases long-range planning is called for, and the accumulation of a replacement fund may be the best way to meet the situation. The more vulnerable financially the concern involved, the more important it will be to consider this possibility. The accumulation of a fund also offers possibilities in assuring cash to take advantage of depression conditions and prices.

On the other hand, segregation by the average industrial enterprise of cash assets equal to the entire depreciation charge will practically never be intelligent. Replacements of tools and all but expensive machinery and large buildings will be provided for by ordinary budgeting of funds obtained through the depreciation charge. Funds equivalent to depreciation in early years when replacements are small are permanently released and available for any corporate purpose.

In all cases discretion should be left to competent financial executives to plan the wisest use and sources of funds. If the financial executives are not competent, then accounting techniques cannot prevent disaster. At that point the problem becomes an administrative problem in selection of personnel.

If You Take Instrument Transformers for Granted

(Continued from page 60)

and compensated.

Current transformers are used with ammeters, wattmeters, watt-hour meters, power factor meters, compensators, and various protective and regulating relays. Their main

(Continued on page 85)

HOW TO KEEP TIGHT CONTROL OF YOUR PRODUCT . . .

from plant to user

Many of our customers compliment us on our well-packed shipments.

Our shipments are safer and our shipping costs are less—thanks to Signode Steel-Strapping.

● To stand the gaff in transit . . . to withstand pilfering and damage . . . and to arrive at the buyer's in A-No. 1 shape, a shipment *should be reinforced.* That's why thousands of shippers protect their packages with Signode Steel Strapping.

And in addition to this protection and assurance that their packages will arrive just as they packed them, shippers using Signode System are *showing profits* in their shipping departments, and Signode Packing Engineers have been able to show manufacturers how they *could cut 5 cents to $5.00* off the cost of each shipment. This naturally shows up on the company's books as an increase in net profit. Recently we redesigned a manufacturer's shipping container and showed him how he could reduce its weight 100 pounds and save $1.42 in freight, materials, etc. by using a Signode Steel Strapped-container.

May we mail you a copy of "Guide to Better Packing and Shipping Methods"? It's yours for the asking.

SIGNODE STEEL STRAPPING CO.

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The Carlyle Tile Company of Coalgrove, Ohio, used to ship flat floor tile in a wooden crate with a ⅝" end and three slats of ⅜" wood on each side, reinforced and tied with 13 gauge wires. Now a Signode steel strapped package is used and the savings amount to approximately 12c per package. In addition there is a saving in freight due to the elimination of the two pound crate formerly used.

SIGNODE

Better Packing Headquarters

(Continued from page 82)

purpose is to keep the ratio between currents in the primary and secondary windings approximately constant, instead of having a constant ratio of the primary and secondary voltages. If the combined burden of two or more instruments does not exceed the burden for which the transformer is designed, one transformer can operate a number of instruments.

With both current and potential transformers, the fundamental principle of operation is the same. The primary winding of the current transformer is connected in series with the line; by transformer action the secondary winding delivers to a closed circuit a current proportional to the line current.

The primary of the potential transformer is connected in parallel with the line; by transformer action the secondary delivers a voltage proportional to line voltage.

An instrument voltage transformer is similar to a small distribution transformer except that it is designed for close regulation so that secondary voltage will always be as nearly as possible a fixed percentage of primary voltage. Secondary voltage can never be exactly proportional to primary voltage, or exactly opposite to it in phase for all conditions of load, because of losses in the transformer and magnetic leakage between coils.

Inherent Errors

Two classes of errors are inherent in voltage transformers — ratio errors and phase angle errors. The part of these errors due to exciting current is constant for any particular voltage. It can be reduced to a minimum by using the best quality of iron and working it at a low magnetic density.

That part of the errors due to the load current of the transformer will evidently depend upon the amount of the load. This part of the error can be minimized by designing the transformer with small resistance and reactance. The ratio error can then be minimized for one particular condition of load by compensating the transformer. This means that the ratio of turns is made slightly different from the marked ratio of the transformer so that the secondary voltage will have its correct value at the specified load.

Effect of phase angle need not be considered when using voltmeters, frequency meters, or other instruments or relays which depend upon voltage alone. With wattmeters, watt-hour meters, and other apparatus whose indication depends on the mutual action of a voltage coil and a current coil, the phase angle may be important.

The primary voltage differs in phase from the secondary voltage by a small angle. Indication of the wattmeter will be proportional to that component of the secondary voltage which is in phase with the line current. It can readily be seen that the wattmeter reading will be greater or less than the true power according as secondary voltage lags behind primary voltage or leads it, and that this error will be greater as the power factor of the main circuit is decreased.

Effect of phase displacement cannot, therefore, be compensated for in the transformer, since it depends not only on the constants of the transformer but also on the power factor of the load to be measured. In high-grade instrument transformers the phase angle is very small; for commercial purposes its effect on the reading is negligible.

Accuracy of instrument transformers cannot be changed after the

THE CHARGE OF THE CUPOLA BRIGADE!

"Theirs not to reason why"—if you want to pay men with wheelbarrows to charge a cupola, there's nothing in the world to stop you. But it will cost you plenty. So will some of the other old-fashioned methods.

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P&H material handling engineers have a wealth of experience to help you with your problems. If they can't show you a way to save money, they'll frankly tell you so. Why not call one in? Or ask us to send you Bulletin RH-2.

Safety catches, which ride above I-beam flange, make it impossible to derail this unit should a heavy jolt occur. It's 100% safe.

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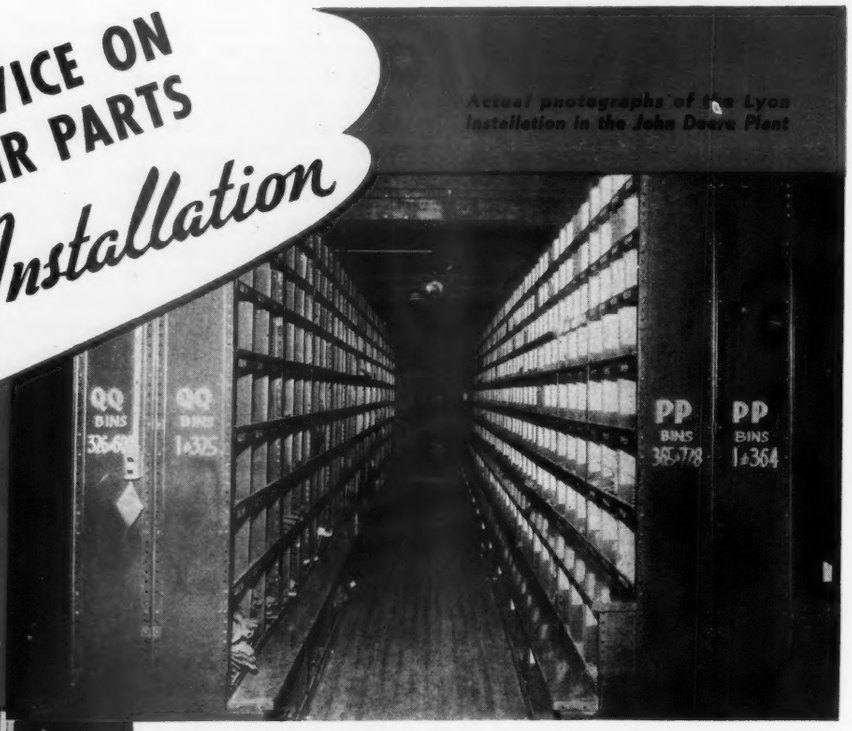
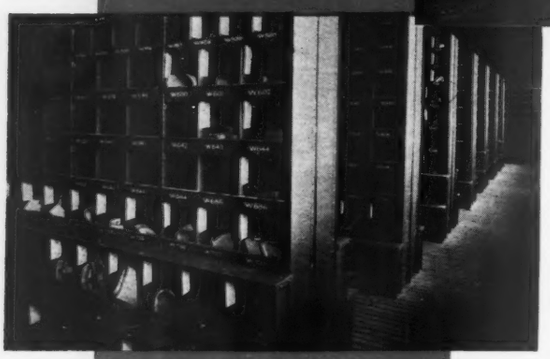
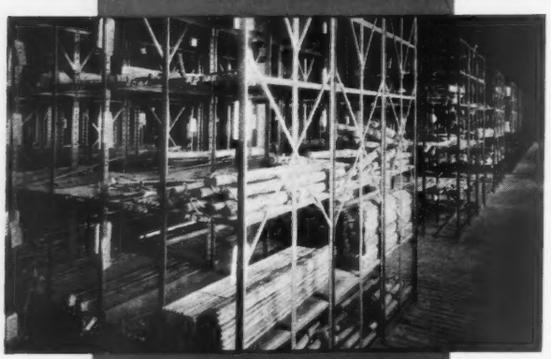


Actual photographs of the Lyon installation in the John Deere Plant

Lyon Steel Shelving is designed to meet the demands of flexibility, required for the storage of items of varied sizes and shapes.



Lyon Storage Equipment is built to stand the hard use of industrial service.



The special construction of Lyon Storage Equipment makes it especially adaptable to changing plant requirements.

● The recent John Deere Plow Company installation at St. Louis, providing storage for 22,000 different kinds of parts, is another example of Lyon's ability to handle widely varied stock and storage problems.

Because of the flexibility of Lyon Steel Shelving and the experience of Lyon Engineers, John Deere Company executives were able to solve their complex parts storage problems. The filling of repair part orders, now requires but a few minutes. Covering thirty thousand square feet of floor space, the new Lyon installation makes possible the instant location of any one of these thousands of repair parts.

The possible annual savings in stock, storage and handling costs, warrant the earnest consideration of executives in every line of business.

Lyon Engineers have saved time and floor space for many companies. In addition to improving their stores handling methods with improved facilities, many of these companies have also cut costs and reduced inventory. Why not call in a Lyon Representative? You will not be obligated.

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transformer is built except by some change in the magnetic circuit which changes the exciting circuit. Since the exciting current is small and modern transformer iron is nonaging, it is safe to assume that the original calibration of a well-designed transformer is permanent.

It Must Not Fail

Current transformers, like voltage transformers, must first of all be reliable. The conditions they mee are even more severe. If trouble develops in a voltage transformer, it may burn itself free or blow its fuses, without affecting the main power circuits. Current transformers, however, are necessarily connected in series with the line and must withstand any condition that develops in the line. In addition they must continue to do their work, since all the protective apparatus usually operated in the secondary circuits of current transformers is dependent on their reliability.

Translated into mechanical characteristics this means that current transformers must not only be well insulated, but also have sufficient cross-section of copper so that they will not seriously overheat on short circuits. A poorly designed current transformer may be burned out or torn to pieces mechanically during a heavy short circuit.

Questions and Answers

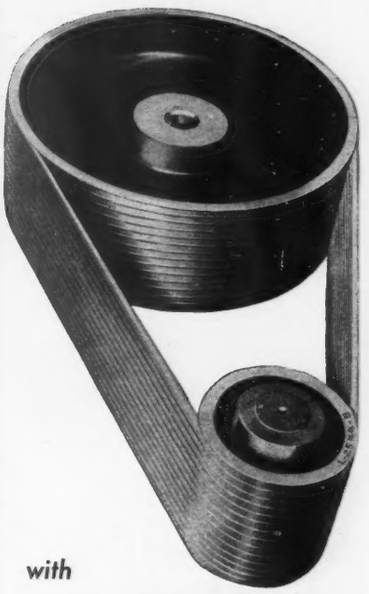
(Continued from page 69)

this information is not available, or to supplement it, your salesmen can help a good deal if you show them how by reporting the reactions of retailers. If you sell through a jobber, as many small firms do, it might pay one of your executives to go out with the jobber's men to get these reactions.

Even with the greatest care in making estimates the trend is distinctly towards more cautious commitments in manufacturing. One large and successful hosiery firm issues initial orders, at the beginning of the season, for only 40 per cent of the carefully estimated demand for each item. If this demand fails to develop, they have no large stocks to dispose of; if the number proves to be popular, they have enough stock ahead so that they can take care of the first orders and step up production in time to fill those that come later.

Adaption of some of these methods to your plant should make it possible for you to get much better control, without expensive changes in the layout or additions to the force.

WORTHINGTON
MULTI-V-DRIVE



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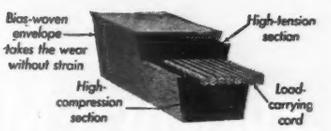

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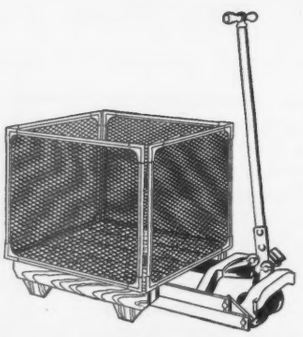
A Steelcrete Handbook outlining many uses for Expanded Metal will be mailed upon request. Inquire also about Steelcrete Industrial Fence made of Expanded Metal.



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Removing Dust from Overhead Piping

Keeping our garment factory clean presents a problem on which we should like to have help. Every time a piece of cloth is cut a certain amount of dust is formed, consisting of bits of fiber. This material settles thickly on the overhead piping and structural work, and is likely to be blown around when there is a draft.

Use of vacuum cleaning is not very satisfactory. It takes a long time to go over all of the overhead piping. The operator has to stand on a ladder or use a piece of stiff tubing with a suitable fitting at the end, which hampers him and the other workers.

We have considered using vacuum cleaning once a month, and brushing the dust off once a week, but are not sure that this scheme would be satisfactory.

How would you solve this problem? —*C.Q.C.*

UNDER the conditions outlined it is preferable to remedy the trouble as close as possible to the source.

This leads to the suggestion that a pipe or duct with an enlarged opening in one end, with the other connected to an exhaust fan, be located as close as practicable to the cloth cutting machines. The discharge from the duct should be led to a dust collector. The size of pipe, fan, and motor will depend entirely on the amount of dust given off.

In this way it should be possible to collect most of the dust at the point where it originates, and thus do away with the inconvenience of cleaning overhead pipes and structural work.

Dust collection systems of this general type are used in woodworking plants for handling sawdust, as well as in many other industries, and there seems to be no reason why such a system could not be adapted to the conditions outlined in the question.

CHARLES H. HUGHES, *New York*

•

ON THE CALENDAR

NOVEMBER

18-20, National Foreign Trade Convention, Chicago. James A. Farrell, Chairman, National Foreign Trade Council, 26 Beaver St., New York.

18-20 Thirty-Seventh Annual Convention, International Acetylene Association, St. Louis, H. F. Reinhard, Secretary, 30 East 42d St., New York.

30-December 4, Annual Meeting, American Society of Mechanical Engineers, New York, C. E. Davies, Secretary, 29 West 39th St., New York.

30-December 5, Twelfth National Exposition of Power and Mechanical Engineering, Grand Central Palace, New York.

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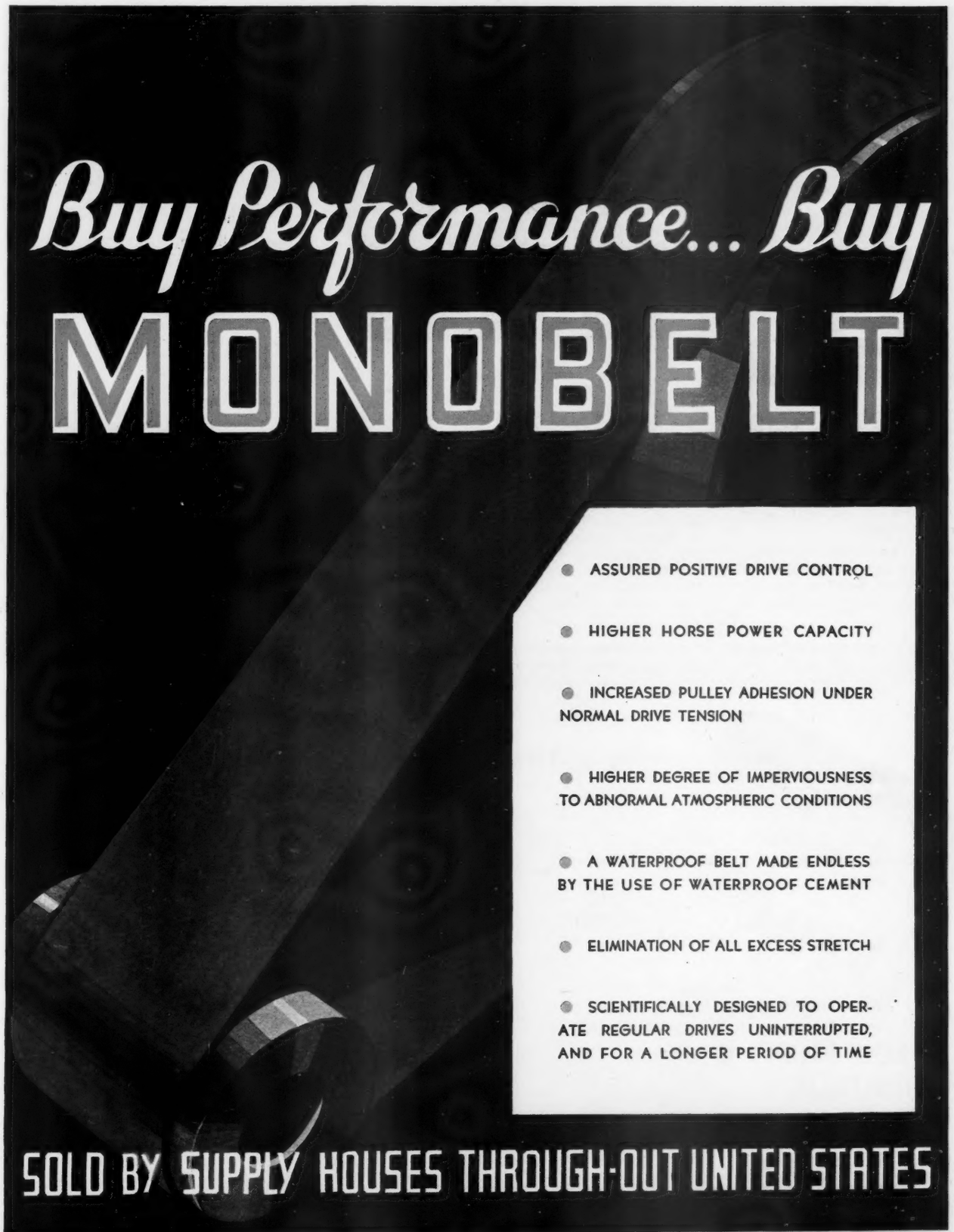
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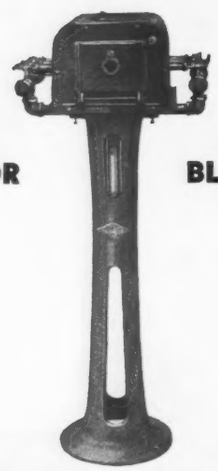

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Eastern Representative: J. H. McPHERSON 250 Stuart Street Boston, Mass.

TRADE LITERATURE

(Continued from page 74)

flow, and liquid level.—The Brown Instrument Co., Wayne and Roberts Aves., Philadelphia.

Controls—Bulletin G-9, describing line of controllers, valves, and timers. Bulletin G-10, on motor-operated controllers. — Automatic Temperature Control Co., Inc., 34 East Logan St., Philadelphia.

Cranes — Booklet, on overhead electric traveling cranes.—The Cleveland Crane & Engineering Co., Wickliffe, Ohio.

Dial Indicator — Folder, describing low-friction, full-jeweled dial indicator.—Federal Products Corp., 1144 Eddy St., Providence, R. I.

Drier—Folder No. 1511, describing Rotary Louvre Dryer for granular materials, chemicals, etc.—Link-Belt Co., 300 West Pershing Rd., Chicago.

Electrical Equipment—Catalog No. I-936, on motors and electrical maintenance equipment.—Ideal Commutator Dresser Co., Sycamore, Ill.

Electrical Equipment—Catalog, on line of electrical controlling and distributing apparatus.—Bull Dog Electric Products Co., Detroit.

Heat Transfer Surfaces—Catalogs 536 and 636, showing applications of heat-transfer surfaces.—Young Radiator Co., Racine, Wis.

Humidity Control—Leaflet describing control made of insertion humidistat and solenoid water valve.—Julien P. Friez & Sons, Inc., Baltimore, and Supreme Electric Products Corp., Rochester, N. Y.

Induction Motors — Six bulletins: GEA-1326B, on totally inclosed, fan-cooled; GEA-1341C, on explosion-proof for Class 1, Group D locations; GEA-1366A, on hoist; GEA-1538A, on Type K totally inclosed; GEA-1619B, on splashproof; GEA-2345, on general-purpose, squirrel-cage.—General Electric Co., Schenectady.

Lockers—Catalog, covering line of lockers.—Lyon Metal Products, Inc., Aurora, Ill.

Lubrication — Booklet, title "Research Illustrated — Lubrication Edition." — E. F Houghton & Co., 240 West Somerset St., Philadelphia.

Mechanical Power Transmission—Bulletin, on line of silent chain drives, couplings, and roller chain.—Morse Chain Co., Ithaca, N. Y.

Motor-Generator — Leaflet, describing Chandeysson motor generators.—The Udylite Co., 1651 East Grand Blvd., Detroit.

Nickel Alloy Steel—Bulletin P-1, on properties and applications of heat treated wrought nickel alloy steels.—The International Nickel Co., Inc., 67 Wall St., New York.

Panelboards—Circular No. 137, describing Swing-Wa panelboards.—The Trumbull Electric Mfg. Co., Plainville, Conn.

Pipe Threading — Operator's instruction book for stationary pipe die heads and threading and cutting machines. — Landis Machine Co., Inc., Waynesboro, Pa.

Pipe Tools—Catalog No. 37, on line of pipe machines and tools.—Beaver Pipe Tools, Inc., Warren, Ohio.

Plastic Tubing — Folder, on properties, shapes, and characteristics of laminated plastic tubing.—Synthane Corp., Oaks, Pa.

Pre-Finished Metals — Folder, describing line of pre-finished metals.—American Nickeloid Co., Peru, Ill.

Production Control System—Folder, describing signaling equipment for controlling production in a newspaper plant.—International Business Machines Corp., 270 Broadway, New York.

Protective Coating — Bulletin 281-A, on Triple-A No. 20 Heavy Duty Black, a protective coating for steels.—Quigley Co., Inc., 56 West 45th St., New York.

Pump—Bulletin W-318-B5A, on two-stage volute, Type UB centrifugal pump.—Worthington Pump and Machinery Corp., Harrison, N. J.